CA2ONER59
70F42

Report
FLOOD & EROSION CONTROL
TOWN OF STONEY CREEK

Hamilton Region
Conservation Authority

FENCO

Foundation of Canada Engineering Corporation Limited

-416467

Report

FLOOD & EROSION CONTROL TOWN OF STONEY CREEK .

Hamilton Region
Conservation Authority

FENCO

Foundation of Canada Engineering Corporation Limited

FOUNDATION OF CANADA ENGINEERING CORPORATION LIMITED

TELEPHONE
AREA CODE 416
549-2458

505 WOODWARD AVENUE
HAMILTON, ONT.

MAILING ADDRESS
P.O. BOX 245 STATION C
HAMILTON, ONT.

June 8, 1970

Mr. B. W. Vanderbrug
Director of Operations &
Secretary-Treasurer
Hamilton Region Conservation
Authority
71 Leland Street
Hamilton, Ont.

Dear Sir,

We take pleasure in submitting our report on the Stoney Creek Flood and Erosion Control Study, carried out in general conformity with requirements itemized in our August 28, 1969 proposal to you.

Essentially, there are two basic causes for the problems encountered, namely flooding and erosion, of both Stoney Creek and Battlefield Creek through the Town of Stoney Creek. Remedial works for the alleviation of these problems are proposed. The proposed works are designed to convey the design flow within the channel, without erosion, with very little wear.

In the assessment of the flood flows, we have used the existing conditions of the watersheds, since no significant changes are presently planned for the area. It is suggested that any substantial increases in runoff peak flow due to future watershed modifications be contained by additional storage within the watershed.

In carrying out this work, we have encountered some unique features peculiar to these watersheds. It was found that during severe storms the runoff from the Stoney Creek watershed would overflow into the Battlefield Creek Watershed from which it would overflow into the Redhill Creek Watershed. This led to an investigation of the possibility of utilizing this feature in a controlled manner for the purpose of minimizing the remedial works required.

It was found, however, that the encroachment by buildings on the flood plains was so severe that enlargement of the channels in the

TABLE OF CONTENTS

	Page
INTRODUCTION	1
SCOPE OF WORK	2
DESIGN CRITERIA	4
HYDROLOGY	5
Precipitation	
Runoff	
Watershed Urbanization	
EXISTING CHANNEL CONDITIONS	9
PROPOSED FLOOD CONTROL	11
CHANNEL IMPROVEMENTS	12
Design Flow Rates	
Channel Linings	
Stoney Creek Improvements	
Battlefield Creek Improvements	
Conditions Below Highway 8	
TABLE I	17
TABLE II	18
RECOMMENDATIONS AND CAPITAL COST ESTIMATE	19
DISCUSSION OF RESULTS	23
WATERSHED STORAGE IMPROVEMENTS	25
APPENDIX I - FIGURES	
APPENDIX II - PHOTOGRAPHS	
APPENDIX III - SOILS REPORT	

INTRODUCTION

The Hamilton Region Conservation Authority has retained Foundation of Canada Engineering Corporation Limited (FENCO) to carry out a preliminary engineering study for Flood and Erosion Control within the Town of Stoney Creek, Ontario. The purpose of the study was to evaluate present channel conditions with respect to the effect of possible peak flood conditions and to evaluate the cost of improving the existing channels of Stoney Creek and Battlefield Creek. This report contains the results of the study.

SCOPE OF WORK

The following work has been carried out to prepare this report:

1. Examination of available topographic, hydrological and meteorological data.
2. Determination of channel slopes and representative cross-sections.
3. Calculation of 100-year peak runoff for Stoney and Battlefield Creeks.
4. Development of hydrographs for the two drainage areas above the escarpment.
5. Synthesis of the Hurricane Hazel storm centred on the watersheds using unit hydrographs for both Stoney and Battlefield Creeks.

6. Determination of drainage and channel characteristics of the watershed above the escarpment to determine the maximum probable runoff for any particular storm for Stoney and Battlefield Creeks.

7. Calculation of flood water surface profiles in the existing channels of Stoney and Battlefield Creeks through the Town of Stoney Creek.

8. Determination of suitable cross-sections and channel linings for the existing channel dimensions and present flood flow rates of Stoney and Battlefield Creeks.

9. Calculation of flood water surface profiles with the proposed channel cross-sections and channel linings for Stoney and Battlefield Creeks.

10. Preparation of a capital cost estimate of the proposed improvements.

11. Examination of the effect of the channel improvements on the condition of Stoney and Battlefield Creeks below Highway No. 8.

12. Investigation of soils along the channels of Stoney and Battlefield Creeks within the Town of Stoney Creek.

DESIGN CRITERIA

1. The purpose of the channel improvements is to alleviate flooding and erosion within the populated areas of the Town of Stoney Creek, from Stoney and Battlefield Creeks.

2. The design peak flow rates are determined by projected meteorological conditions as well as future watershed and channel conditions.

3. Proposed channel cross-sections are governed by high water flow profiles, construction easement availability and soil conditions.

4. Existing bridges and structures must be considered when channel cross-sections and resulting flow profiles are established.

HYDROLOGY

Precipitation

Rainfall records from the Department of Transport, Meteorological Branch, Atlas of Rainfall Intensity - Duration - Frequency Data for Canada have been extrapolated to produce the intensity - duration frequency curves of Figure 1. The 100-year storm precipitation was used to calculate the design runoff flow rates. A hyetograph of rainfall at the centre of Hurricane Hazel has been taken from the data in the Department of Transport Publication CIR-2606 "Hurricane Hazel," and is shown in Figure 4. The records have been used to synthesize a storm of Hurricane Hazel magnitude centered on the watershed.

Runoff

Figure 2 shows the drainage area of both Stoney Creek and Battlefield Creek watersheds above the escarpment. Synthesized hydrographs (100-year flood) for the watersheds above the escarpment are shown in Figure 3. Rainfall from a storm of Hurricane Hazel magnitude has been used to estimate the effects of a storm of major proportion on the watershed. The predicted runoff hydrograph of this storm is shown in Figure 4.

Flood frequency curves for peak runoff from local storms on the Stoney Creek and Battlefield Creek watersheds are shown in Figures 5 and 6 respectively. These curves represent the runoff rate that reaches the edge of the escarpment. Local peak runoff within the Town of Stoney Creek will not coincide in time with the peak runoff from either watershed above the escarpment and therefore does not materially affect the peak flow rates.

An examination of the Stoney Creek drainage area shows that an ancient floodway passed at the edge of the escarpment from the larger Stoney Creek watershed to Battlefield Creek and possibly all the runoff went down the Battlefield Creek floodway. Under present conditions, the Stoney Creek outlet above the escarpment conveys runoff down Stoney Creek from all but the severest floods. A flood from a storm of Hurricane Hazel magnitude would still cause overflow into the ancient floodway and Battlefield Creek. Essentially, the flow conditions would be as follows for a storm of Hurricane Hazel magnitude.

The bankfull flow in the channel upstream of the Devil's Punch Bowl Bridge is approximately 500 cfs. Flow in excess of this overflows the banks and spreads out on the flood plain. The

Runoff (continued)

water level would continue to rise as the inflow increased. With the water level at the 610 foot elevation, the flow through the bridge would be approximately 1500 cfs. When the inflow into this storage area (see Figure 2) exceeds 1500 cfs, the water rises above the 610 foot elevation and overflows the road into the Devil's Punch Bowl. Water would also overflow into the ancient floodway and thence into Battlefield Creek (see Photographs 12 and 13). From a storm of Hurricane Hazel magnitude, the peak rate of runoff from the Stoney Creek watershed above the escarpment is estimated to be approximately 4200 cfs. This would be the peak inflow into the storage above the bridge. It is estimated that the outflow would be approximately 3000 cfs, of which some 2500 cfs would flow into the Devil's Punch Bowl and Stoney Creek, and 500 cfs down the ancient floodway into Battlefield Creek (see Figure 7).

If the water from Stoney Creek is prevented from overflowing into Battlefield Creek, and the floodway above the escarpment is sufficiently enlarged, a peak flow of approximately 4000 cfs could be experienced in Stoney Creek.

Runoff from a storm of Hurricane Hazel magnitude centered on the Battlefield Creek watershed would produce a peak flow rate of 1000 cfs. However, since such a storm would also be simultaneously centered on the Stoney Creek watershed, there would be the additional flow of 500 cfs (the Stoney Creek overflow described above) for a total of 1500 cfs.

The flow in Battlefield Creek into the Town of Stoney Creek is controlled by the existing Highway 20 culverts shown in Figure 7 (see Photographs 14 and 15). The final culvert acts as a

Runoff (continued)

restriction to the flow, passing a maximum of approximately 1300 cfs. Excess flow would overflow into the Redhill Creek watershed, as shown on Figure 7 and on photograph 15.

Because of the relatively small watershed, the runoff from a storm of Hurricane Hazel magnitude is less than runoff from a 100-year local storm in Battlefield Creek. The peak rate of runoff from a 100-year storm is estimated at approximately 1900 cfs at the escarpment brink. However, due to the small volume of runoff from a 100-year storm, the sharp peak flow will be regulated by the Highway 20 culverts at Ridge Road and Green Mountain road. The flow rate effective in the Battlefield Creek channel would consequently be less than 1000 cfs, which is also the effective flow from Battlefield Creek during Hurricane Hazel.

Watershed Urbanization

The runoff is calculated on the basis of the present watershed condition, since no urbanization is planned for at least 20 years. The runoff and peak flow would be increased with increased urbanization of the watershed. However, for a storm such as Hurricane Hazel the precipitation antecedent to the main rainfall would be sufficient to saturate the ground and fill any hollows. Consequently, the peak rate of runoff from an exceptionally severe storm would not be greatly different between an urbanized and an agricultural watershed.

EXISTING CHANNEL CONDITIONS

Both Stoney Creek and Battlefield Creek, within the Town of Stoney Creek, have sections with relatively steep slopes and high flow velocities, resulting in considerable erosion, and relatively mild slopes with high flood stages and excessive flooding. Due to existing channel conditions, property owners have found it necessary to take their own measures for flood and erosion protection. Photographs of selected reaches of Stoney Creek and Battlefield Creek (Appendix II) show various remedial measures taken by property owners, and the erosion that has taken place regardless of their efforts. In certain reaches people's efforts, such as restrictions of the channel cross-section, have adversely affected the properties of upstream home owners and businesses.

Channel bottom profiles and cross-sections have been determined by actual survey for Stoney Creek and Battlefield Creek from Highway

EXISTING CHANNEL CONDITIONS (continued)

No. 8 to the Toronto - Hamilton and Buffalo railway line. A large scale drawing containing the measurements will be submitted separately to the Authority.

Estimated flood lines for peak flow rates of 1500 cfs and 2500 cfs for Stoney Creek, and 1300 cfs for Battlefield Creek are shown in Figures 8 and 9. From these flood lines, it is seen that a need for channel improvement exists in order to contain the design flood within the stream banks. A further reason for improvement is the serious erosion of the stream banks. A report on soil conditions is enclosed as Appendix III.

PROPOSED FLOOD CONTROL

Low existing stream banks of the flood plain and the fact that development has taken place up to the stream banks restrict the size of channel that may be economically constructed through the Town of Stoney Creek. Examination of channel conditions through Stoney Creek shows that the existing channel cross-section dimensions and bottom slopes will conduct a flow of 1500 cfs if proper lining is provided.

In view of the above, it is recommended that the maximum peak flow rates from the Stoney Creek watershed above the escarpment be reduced to 1500 cfs by utilizing the storage areas shown in Figure 2.

With the overflow from Stoney Creek watershed to the Battlefield Creek watershed, via the ancient floodway,eliminated,the maximum peak flow in Battlefield Creek would be 1000 cfs from a storm of Hurricane Hazel magnitude.

CHANNEL IMPROVEMENTS

Design Flow Rates

The proposed Battlefield Creek and Stoney Creek channel improvements through the Town of Stoney Creek have been designed for the following flow rates:

1. Stoney Creek 1500 cfs
2. Battlefield Creek 1000 cfs

Channel Linings

Two types of channel lining are considered suitable for the two channels, namely gabion lining and concrete lining, as shown in Figure 10. The proposed channel improvements would be adequate to contain the design floods within the channel banks and to minimize erosion.

Channel Linings (continued)

To accommodate a flow rate of 1500 cfs within the banks of the existing channel of Stoney Creek, it is necessary to use a concrete lining where the existing bank heights are low. The advantages of a concrete lining as opposed to a gabion lining are shown in Figure 6. It is feasible to use gabion lining on the undeveloped flood plain from chainage 9 + 00 to Highway 8. It is also feasible to re-route this section of the channel through the middle of the flood plain and leave it unlined. However, this would divide the area into two small sections which would reduce the usefulness of the land. It is therefore recommended that the existing channel be gabion lined. The recommended channel cross-section dimensions and linings are shown in Table 1.

Development of this flood land for residential housing has been considered. Building of houses on this flood plain would require that the houses be above the flood level - at least above the 1500 cfs flow flood level. This could be done either by fill on the flood plain or by enlarging the culvert under the highway. Improving the culvert inlet conditions only would not be adequate. Building on fill would require that the foundations go down to the present solid grade, or on piles. Although it is feasible to build in this manner, the added cost would be of the order of some $5,000 per house.

Due to considerable development and the low bank heights in the King Street region of Battlefield Creek, a concrete lined channel is recommended between chainage 25 + 80 and 42 + 20. The recommended cross-section dimensions and linings are shown in Table 2.

Stoney Creek Improvements

Location		Improvements
From	To	
51 + 50	35 + 60	The channel should be excavated to a constant cross-section shown in Table I. A concrete lining should be used to hold the water surface elevation at a minimum to pass through the existing bridges at King and Jones Streets.
35 + 60	26 + 00	A concrete lined channel (see Table I) is required to alleviate the erosion problems and to contain the 1500 cfs flow rate within the existing banks.
26 + 00	9 + 00	A concrete lined channel (see Table I) is required to alleviate erosion and the small amount of flooding from the 1500 cfs flow.
9 + 00	0 + 00	To permit maximum utilization of the flood plain, the existing channel should be gabion lined and of dimensions shown in Table I.
0 + 00	Highway 8	The culverts under Highway 8 should be improved to accommodate the 1500 cfs flow and to minimize the upstream storage and flooding. This can be done by improving the hydraulics of the culvert entrance with wingwalls.

Battlefield Creek Improvements

Location		Improvements
From	To	
66 + 20	42 + 20	The channel should be concrete lined with a bottom width of 16 feet (see Table II). Excavation and considerable clearing will be necessary in this reach.
42 + 20	25 + 30	The channel should be concrete lined to contain the runoff within the existing channel and alleviate overbank flow in the reach of channel where development has occurred. See Table II for channel characteristics.
25 + 30	0 + 00	In this portion of the channel where very little development has occurred, the existing channel may be either gabion lined and the flow contained within the 16' wide gabion channel, or the flood plain may be zoned as park-land with periodic flooding permitted.
0 + 00		The culverts should be improved to accommodate the 1000 cfs flow without excessive upstream storage and flooding. This can be done by improving the hydraulics of the culvert entrance with wingwalls.

Conditions Below Highway 8

The decrease in roughness and overbank storage in a fully lined channel will increase the hydrograph peak for a point downstream of the improved channel. This amplifies the need to ensure that the downstream section of such a channel is adequate. Portions of the channels below Highway 8 have the flow restricted by fallen trees and underbush. An overall programme to improve and maintain the channels should include a clean-up of the downstream reaches in both Stoney Creek and Battlefield Creek. However, because of the existing undeveloped flood plains below Highway 8, no other remedial works are deemed necessary at this time.

Chainage		Lining Used	Cross-Section Shape	Bottom Width B	Side Slopes	Design Water Depth	Average Velocity fps	Channel Depth H
From	To							
0 + 00	9 + 00	Gabions	Trapezoidal	24 ft.	2-1	5.2 ft.	8.4	7.2'
9 + 00	14 + 20	Concrete	Trapezoidal	24 ft.	1-1	3.0 ft.	18.5	5.0'
14 + 20	19 + 00	Concrete	Trapezoidal	20 ft.	1-1	2.9 ft.	21.6	5.0'
19 + 00	21 + 60	Concrete	Trapezoidal	20 ft.	1-1	4.0 ft.	15.7	6.0'
21 + 60	35 + 60	Concrete	Trapezoidal	20 ft.	1-1	3.2 ft.	20.8	5.2'
35 + 60	51 + 50	Concrete	Rectangular	24 ft.	Vertical	2.9 ft.	21.4	5.0'

Refer to Figure 10 for typical cross-sections

TABLE I - SUMMARY OF PROPOSED CHANNEL DESIGN CHARACTERISTICS - STONEY CREEK

(1500 CFS DESIGN FLOW RATE)

Chainage		Lining Used	Cross-Section Shape	Bottom Width B	Side Slopes	Design Water Depth	Average Velocity fps	Channel Depth H
From	To							
66 + 20	42 + 20	Concrete	Trapezoidal	16 ft.	1-1	2.90 ft.	15.9	4.90
42 + 20	37 + 50	Concrete	Rectangular	16 ft.	Vertical	3.60 ft.	17.3	5.60
37 + 50	25 + 80	Concrete	Trapezoidal	16 ft.	1-1	3.00 ft.	15.2	5.00

Refer to Figure 10 for typical cross-sections

TABLE II - SUMMARY OF PROPOSED CHANNEL DESIGN CHARACTERICTICS - BATTLEFIELD CREEK

(1000 CFS DESIGN FLOW RATE)

RECOMMENDATIONS AND CAPITAL COST ESTIMATE

In the recommendation for remedial works in Stoney Creek, it has been assumed that sufficient storage will be provided above the escarpment to limit the flow to 1500 cfs. The storage requirements for this purpose are discussed under the heading "WATERSHED STORAGE REQUIREMENTS."

To eliminate flooding and erosion of the Stoney Creek and Battlefield Creek channels under the recommended design flow rates, it is suggested that the following procedure be adopted. The recommended improvements have been arranged in order of decreasing urgency.

Stoney Creek (refer to Table I)

1. Concrete line the channel from chainage 9 + 00 to 33 + 10 (Jones Street) as shown in Table I.

Unit cost of excavation and lining	$72/ft
Construction Cost	$174,000

2. Excavate the existing channel from 35 + 40 (King Street) to 51 + 40 (Toronto - Hamilton & Buffalo Railroad) to a uniform cross-section with bottom widths shown in Table I.

3. Concrete line the channel from chainage 33 + 30 (Jones Street) to 51 + 50 (Toronto - Hamilton & Buffalo Railroad).

Cost of excavation and lining:	
Jones Street to King Street	$14,000
King Street to T.H.&B. Railroad	$115,000

4. Gabion line the channel from 0 + 00 (Highway 8) to 9 + 00

Unit cost of excavation and lining	$63/ft
Construction cost	$56,700

5. Add wingwalls to the inlet of the culvert under Highway No. 8.

Construction cost	$500
Construction cost for Stoney Creek	$360,200

Battlefield Creek (refer to Table II)

1. Concrete line the channel from chainage 37 + 50 to 42 + 20 (see Table II).

Unit cost of excavation and lining	$74/ft
Construction cost	$31,000

Battlefield Creek (continued)

2. Concrete line the channel from 25 + 80 to 27 + 50.

Unit cost of excavation and lining	$62/ft
Construction cost	$72,500

3. Zone the flood plain from chainage 0 + 00 (Highway 8) to 25 + 80 as parkland which may be inundated at times of extreme flooding.

4. Concrete line the channel from 42 + 20 to 66 + 20 (T.H.& B. Railroad).

Unit cost of excavation and lining	$62/ft
Construction Cost	$149,000

5. Enlarge the channel below Highway 8 to eliminate the flow restriction imposed by the bend just downstream of the culvert.

Construction Cost	$1,000

6. Improve the culvert under Highway 8 to accommodate the 1000 cfs design flow rate.

Construction Cost	$500
Construction Cost for Battlefield Creek	$223,000

Both Creeks

Total Construction Cost	$583,200
Engineering Fees	$ 31,800
Engineering Expenses	$ 2,000
Resident Supervision of Construction	$ 6,000
TOTAL	$623,000

The estimated costs include engineering and construction only. The engineering cost is based on the present APEO fee schedule. The cost of resident engineer during construction is based on the field

operations proceeding without interruption.

Costs of land, right of way, surveys, legal counsel, fees and licences, etc., would be extra.

DISCUSSION OF RESULTS

Below the escarpment in the Stoney Creek channel a flow rate of 1500 cfs is an acceptable maximum in the channel for the following reasons:

1. Housing and business development ot the stream edge restricts the channel width.
2. Cross-section dimensions of the existing channel will accommodate 1500 cfs if properly lined.
3. Stream bed soil conditions, existing bridge structures and existing water and drainage pipes make deepening of the channel unattractive.
4. Existing bridge and culvert structures at stream crossings in the Town of Stoney Creek and the City of Hamilton cause increasing high back-ups if a higher flow rate is experienced.

DISCUSSION OF RESULTS (continued)

The 1500 cfs flow rate may be used for the design of channel improvements if runoff is stored in the Stoney Creek watershed during tropical storms of rare occurrence such as Hurricane Hazel.

In Battlefield Creek, the flood control measures are not as urgent as in Stoney Creek. The peak runoff is much less because of the small watershed area and the network of Highway #20 culverts. Housing development on the flood plain is not as extensive as on Stoney Creek.

WATERSHED STORAGE IMPROVEMENTS

Under present watershed and stream channel conditions, the area within the 610 foot contour immediately upstream of the Devil's Punch Bowl Bridge begins to flood when the runoff rate exceeds approximately 500 cfs (bank full flow). It is estimated that this area will be flooded on the average once every 15 years approximately.

A channel and watershed improvement programme to eliminate extensive flooding above the escarpment, to reduce the Stoney Creek channel flow to 1500 cfs, and to eliminate the overflow to Battlefield Creek requires a storage capacity of 900 acre feet. The volume necessary cannot be economically obtained by utilizing the area immediately upstream of the Devil's Punch Bowl Bridge. It is recommended that the combined areas

WATERSHED STORAGE IMPROVEMENTS (continued)

1, 2, 3 of Figure 2 be utilized during a storm of Hurricane Hazel intensity and duration. These storage areas could be normally used for farming or recreation. The potential of the three areas are:

Area No.	Enclosing Contour	Surface Area
1	630'	120 acres
2	640'	50 acres
3	670'	60 acres
	TOTAL	230 acres

A complete study of storage potential,dykes and control outlets required for the designated areas is beyond the scope of this study and therefore has not been carried out.

An alternative mode of temporary storage has also been considered. Essentially, the storage area would consist of a dyked flood plain on either side of the channel. If an equivalent area of 230 acres is considered, the required water depth would be nearly 4 feet on the average. The required dyke height would have to be at least 5 feet. If a 300 feet wide flood plain were to be considered, the required length of this dyked plain would be some 6-1/2 miles. The dykes would require an additional area of some 50 acres, for a total of 280 acres. The 13 miles of dyke would require over 250,000 cubic yards of earth fill. Even at a nominal $1.00 per cubic yard, the cost of this type of storage would be very high. It is therefore not considered practical.

APPENDIX I - FIGURES

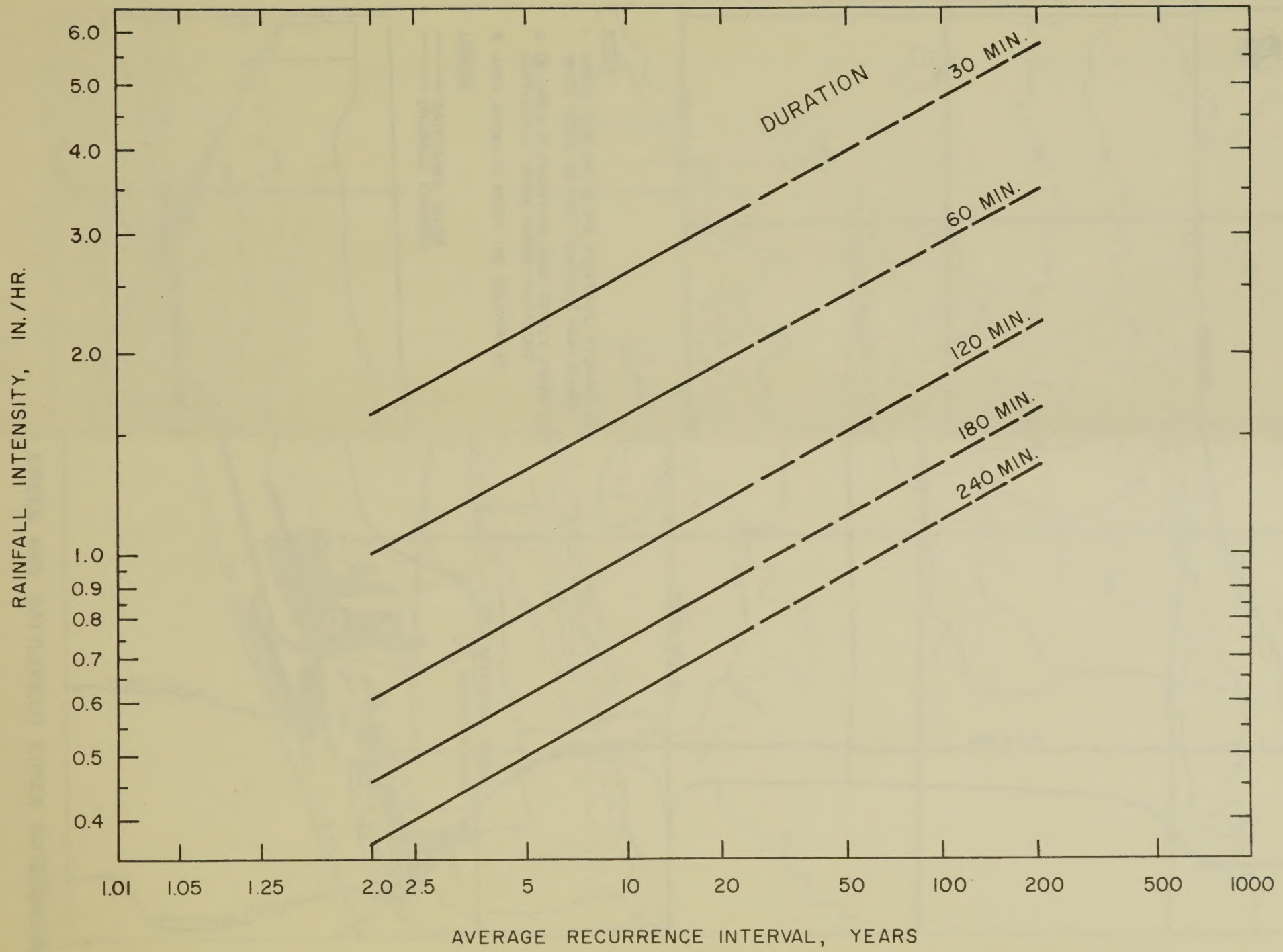
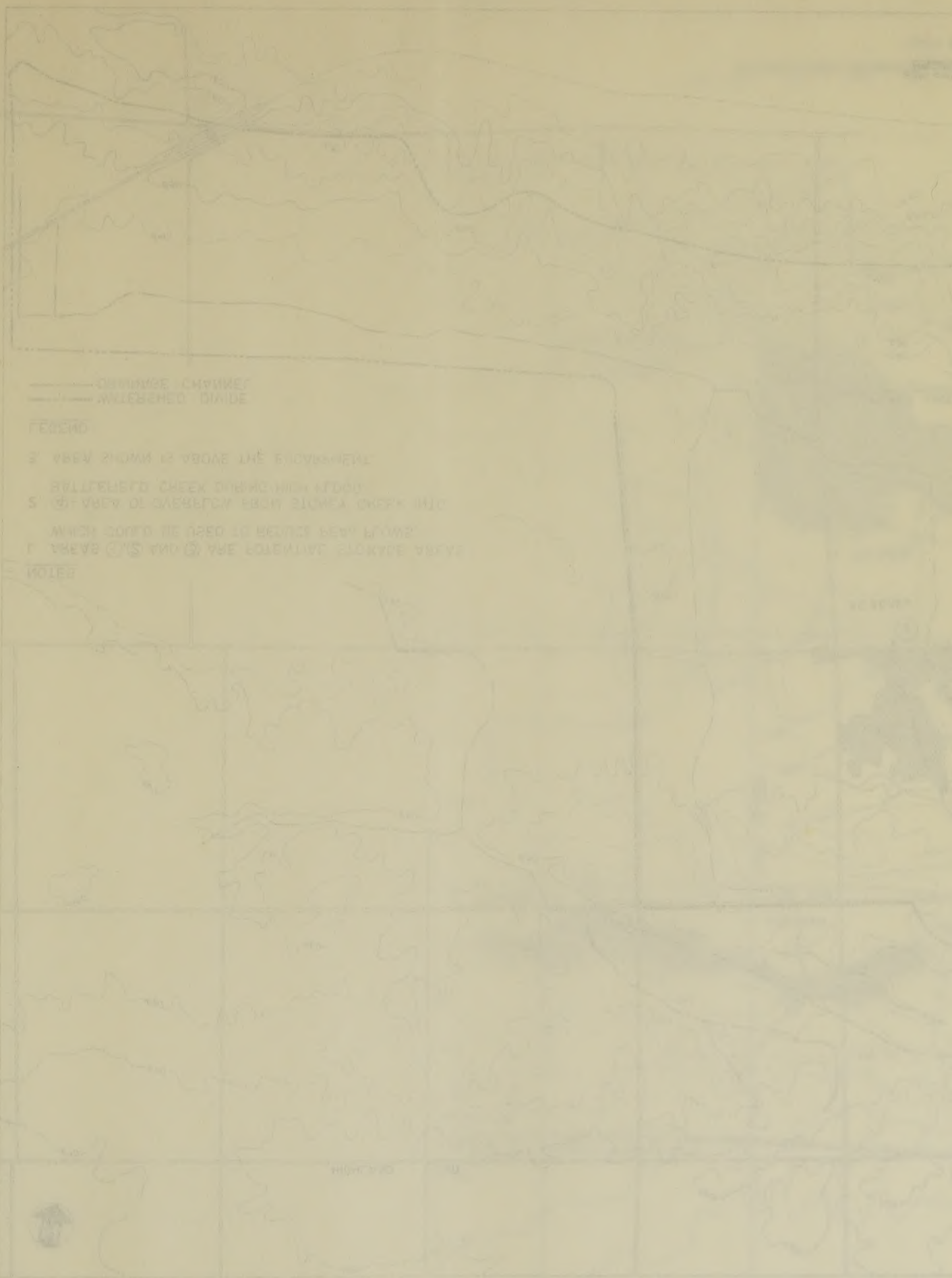


FIG. 1 RAINFALL INTENSITY-DURATION-FREQUENCY CURVES FOR STONEY CREEK AREA

FIG. 2 STONEY CREEK AND BATTLEFIELD CREEK WATERSHEDS

I 3588 - 1



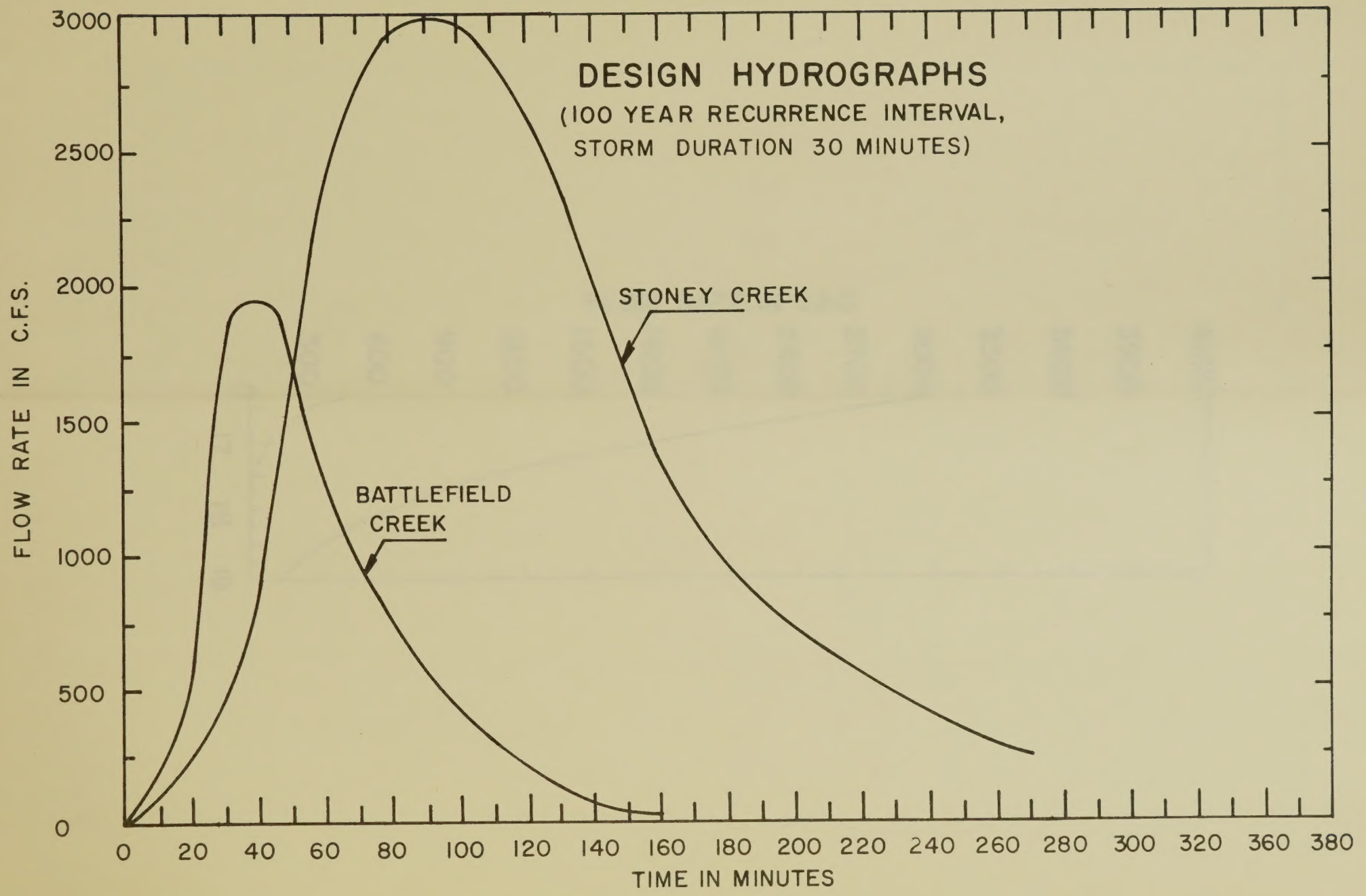
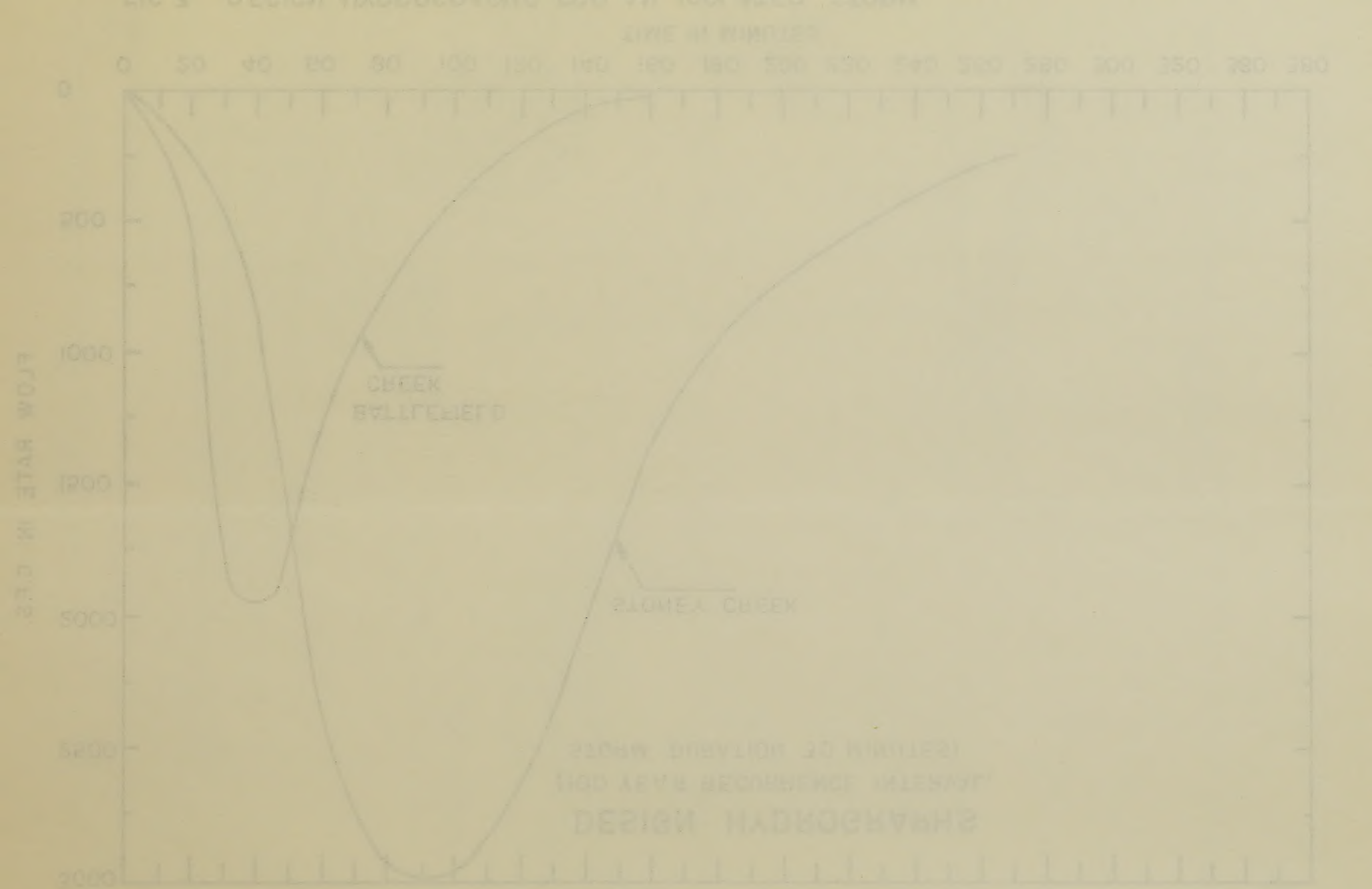


FIG.3 DESIGN HYDROGRAPHS FOR AN ISOLATED STORM



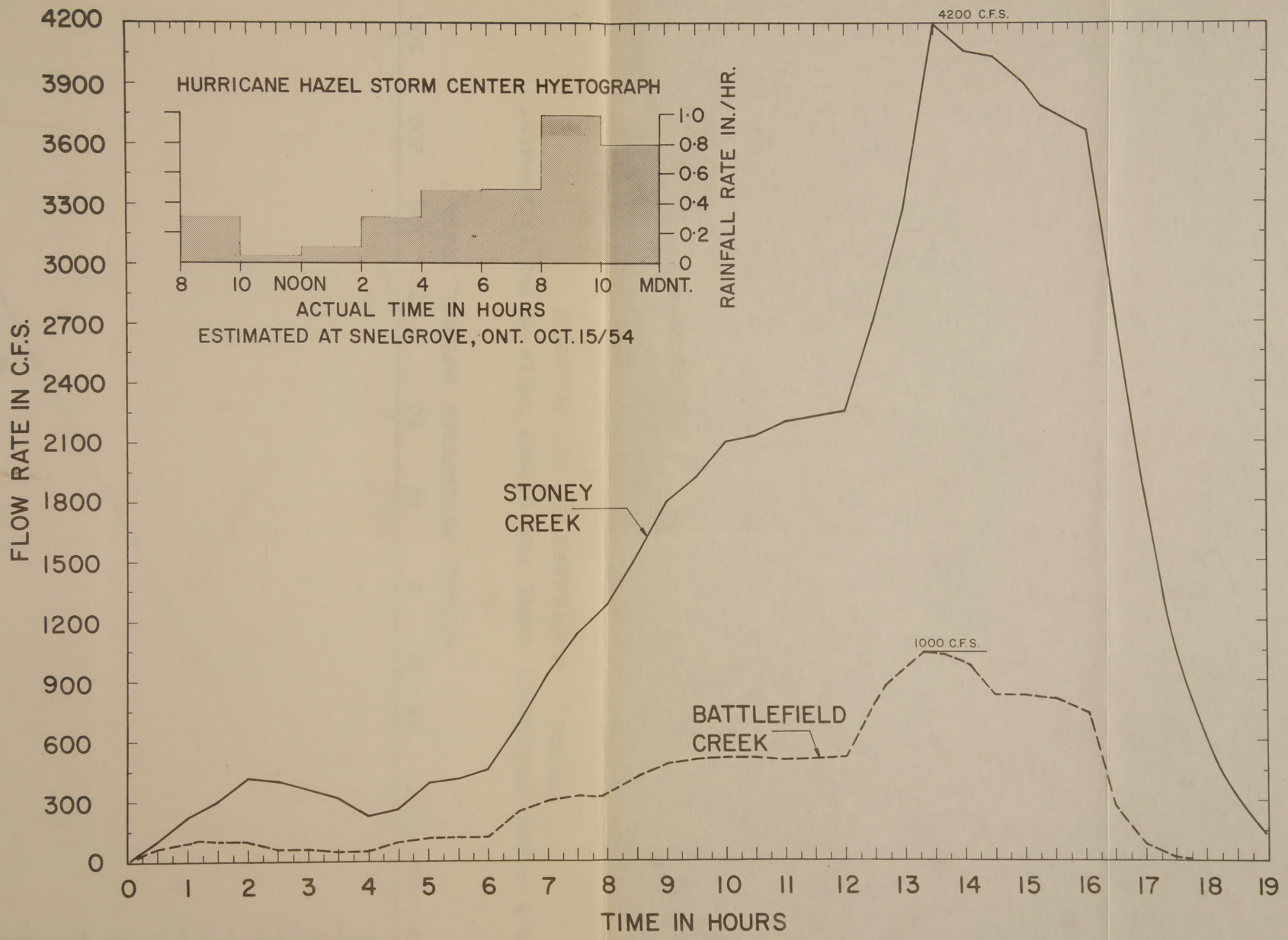
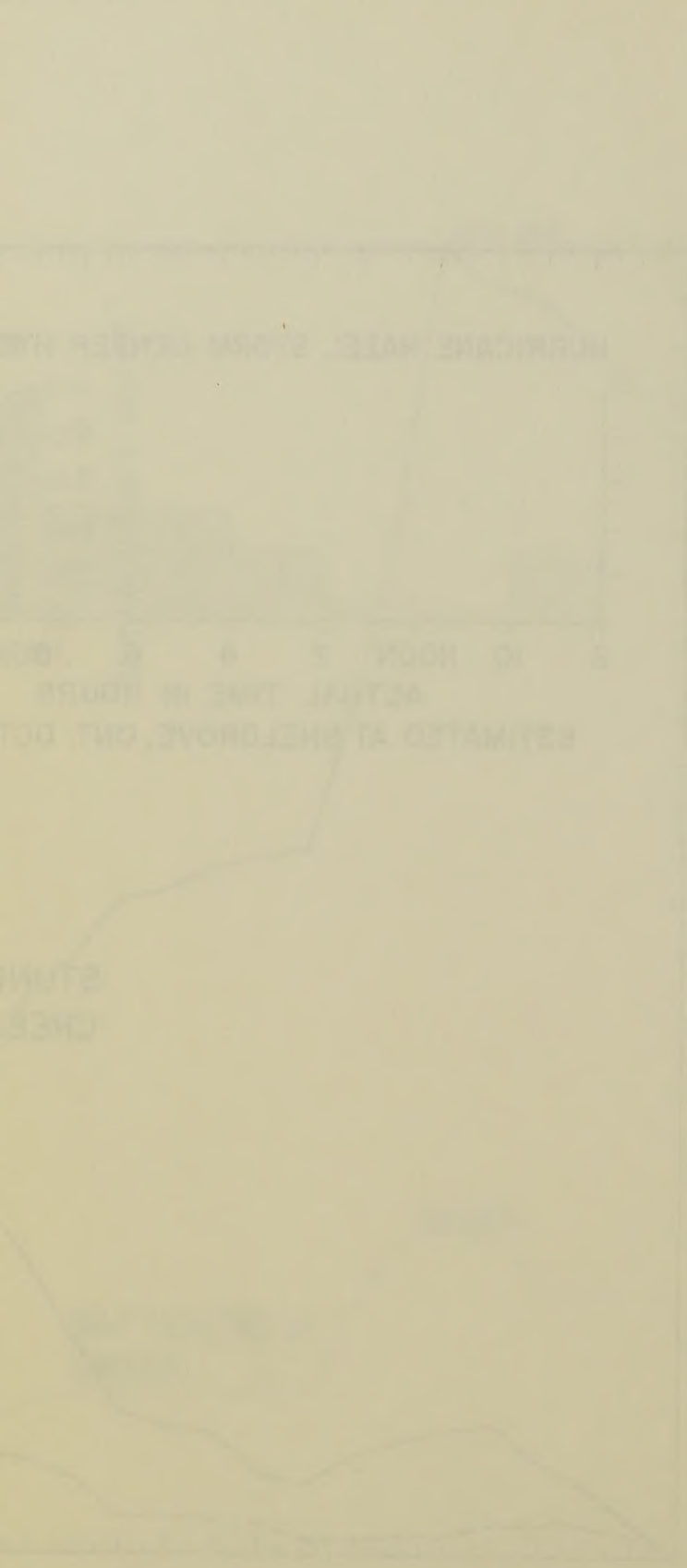


FIG. 4 PREDICTED RUNOFF FROM RAINFALL OF HURRICANE HAZEL INTENSITY AND DURATION CENTERED ON THE WATERSHEDS, AT THE ESCARPMENT.



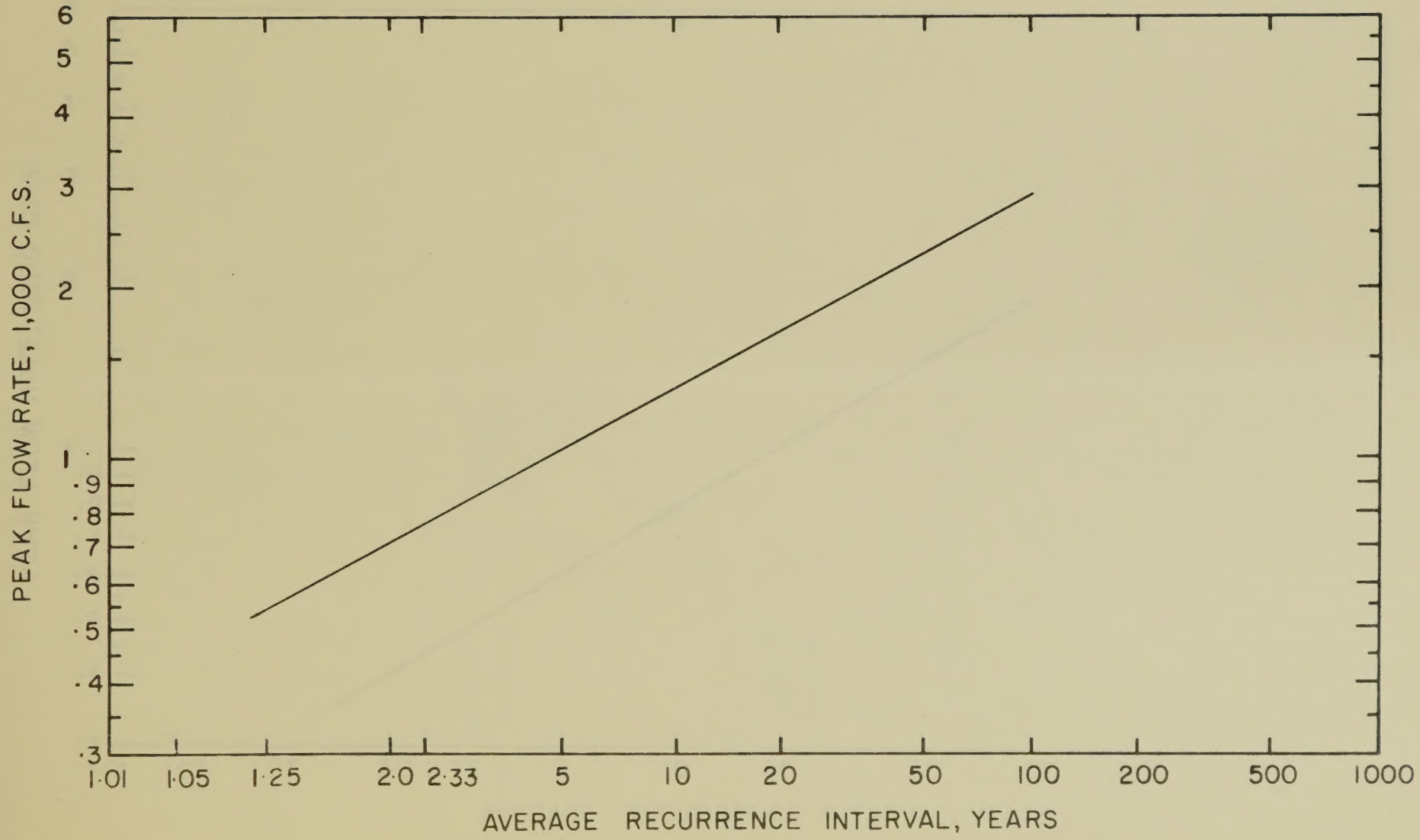
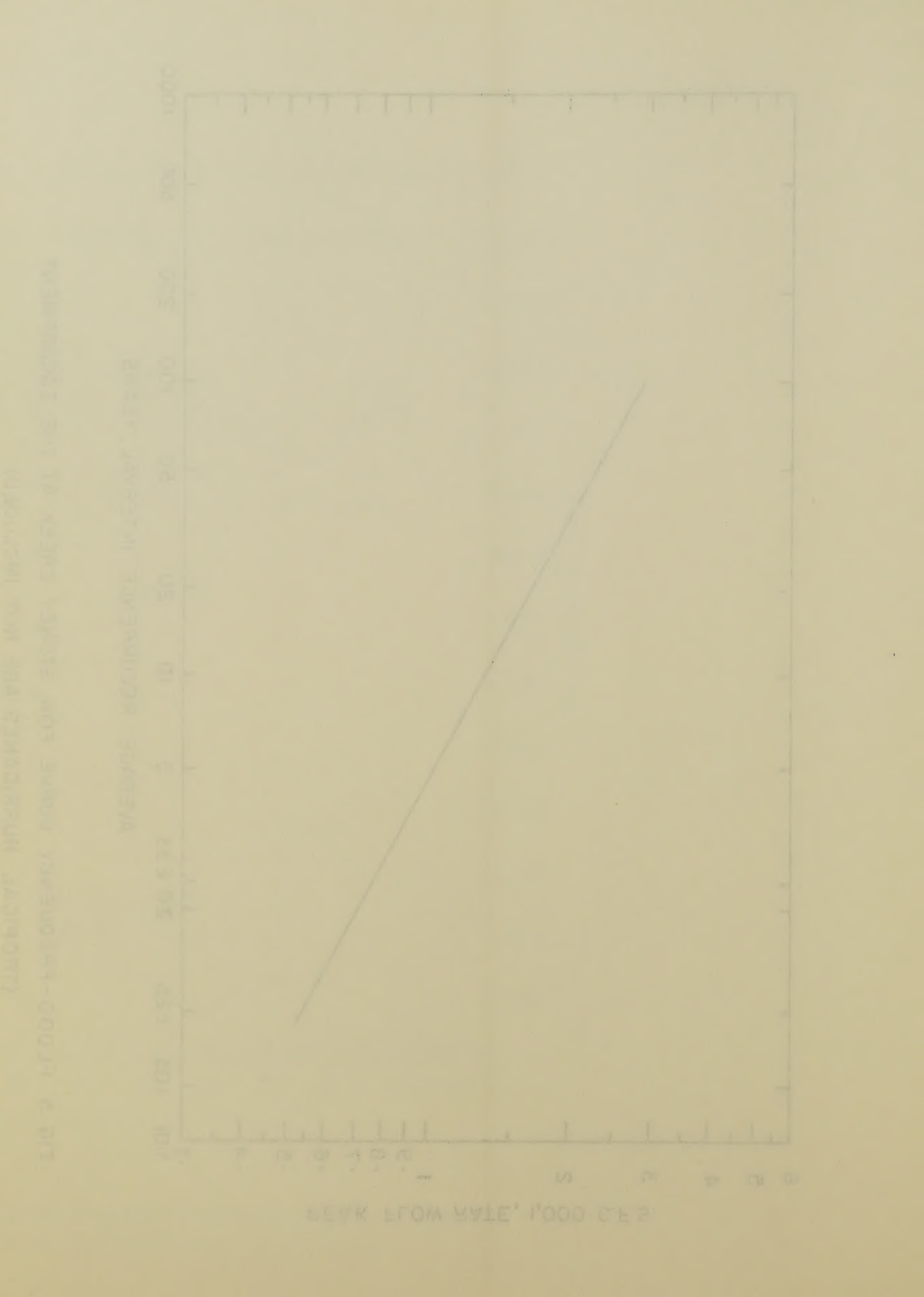


FIG. 5 FLOOD-FREQUENCY CURVE FOR STONEY CREEK AT THE ESCARPMENT
(TROPICAL HURRICANES ARE NOT INCLUDED)



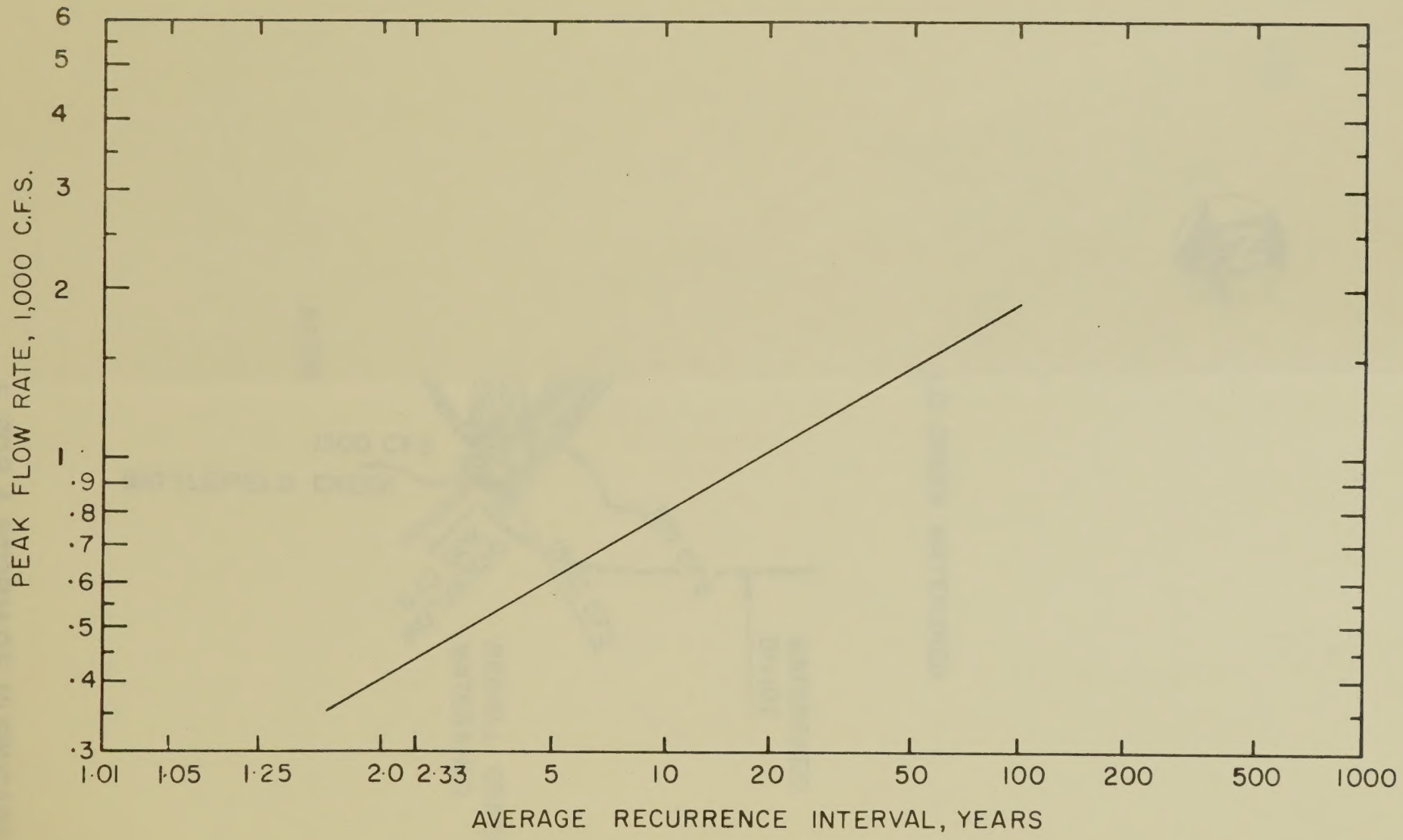


FIG. 6 FLOOD-FREQUENCY CURVE FOR BATTLEFIELD CREEK AT THE ESCARMENT
(TROPICAL HURRICANES ARE NOT INCLUDED)

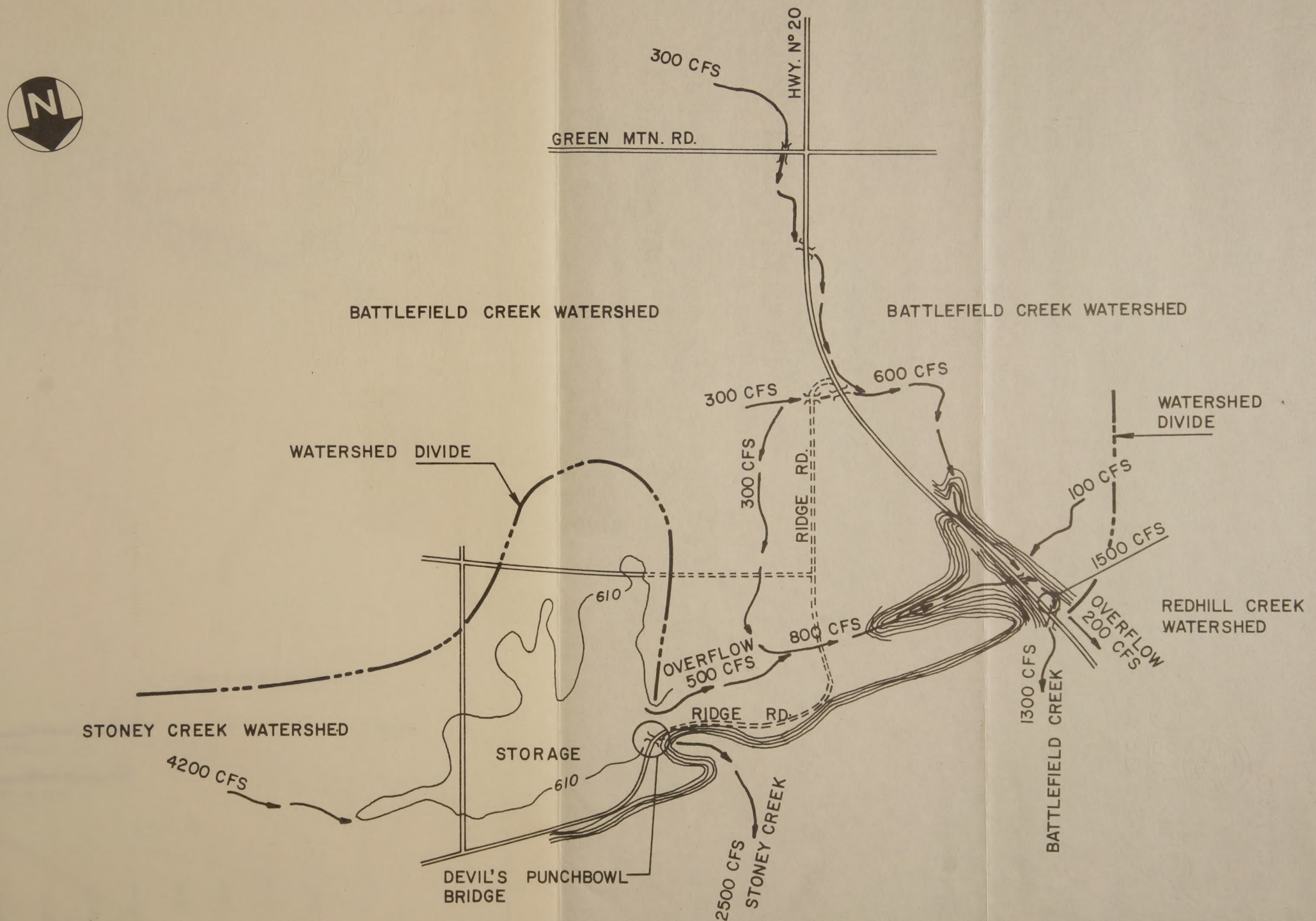
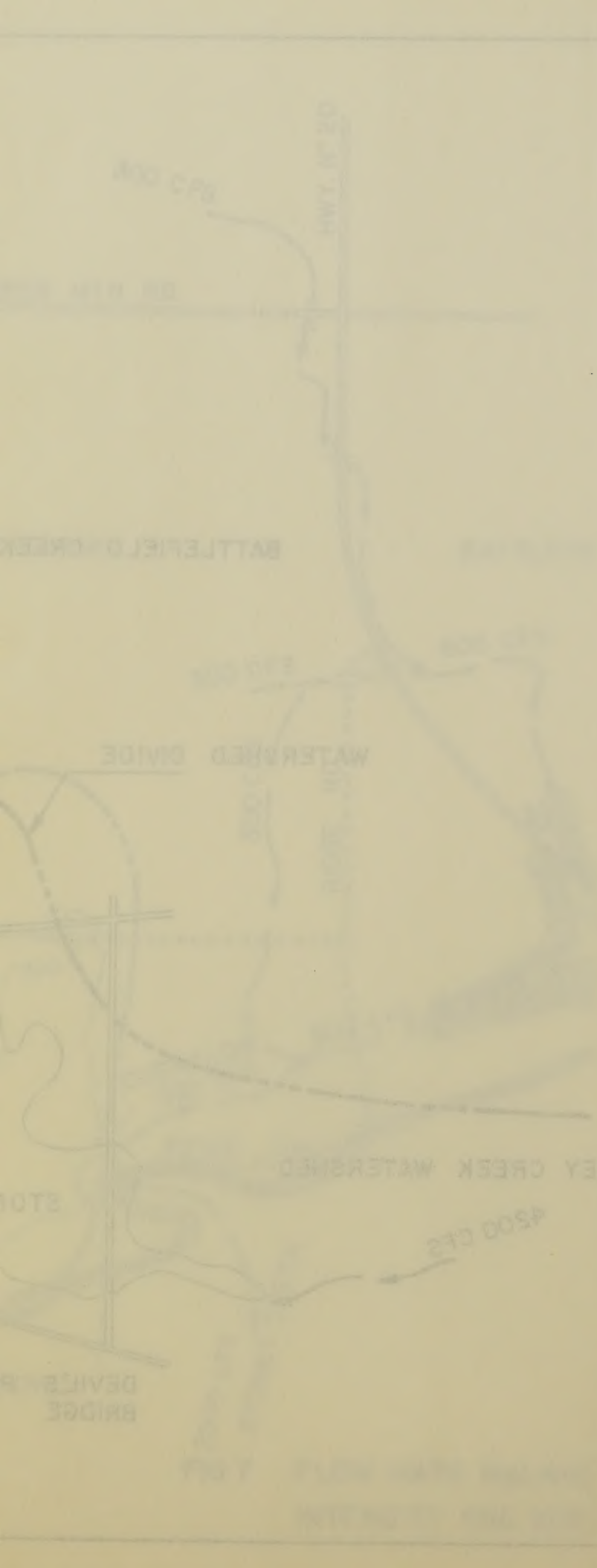


FIG.7 FLOW RATE BALANCE FOR A STORM OF HURRICANE HAZEL INTENSITY AND DURATION UNDER EXISTING CONDITIONS



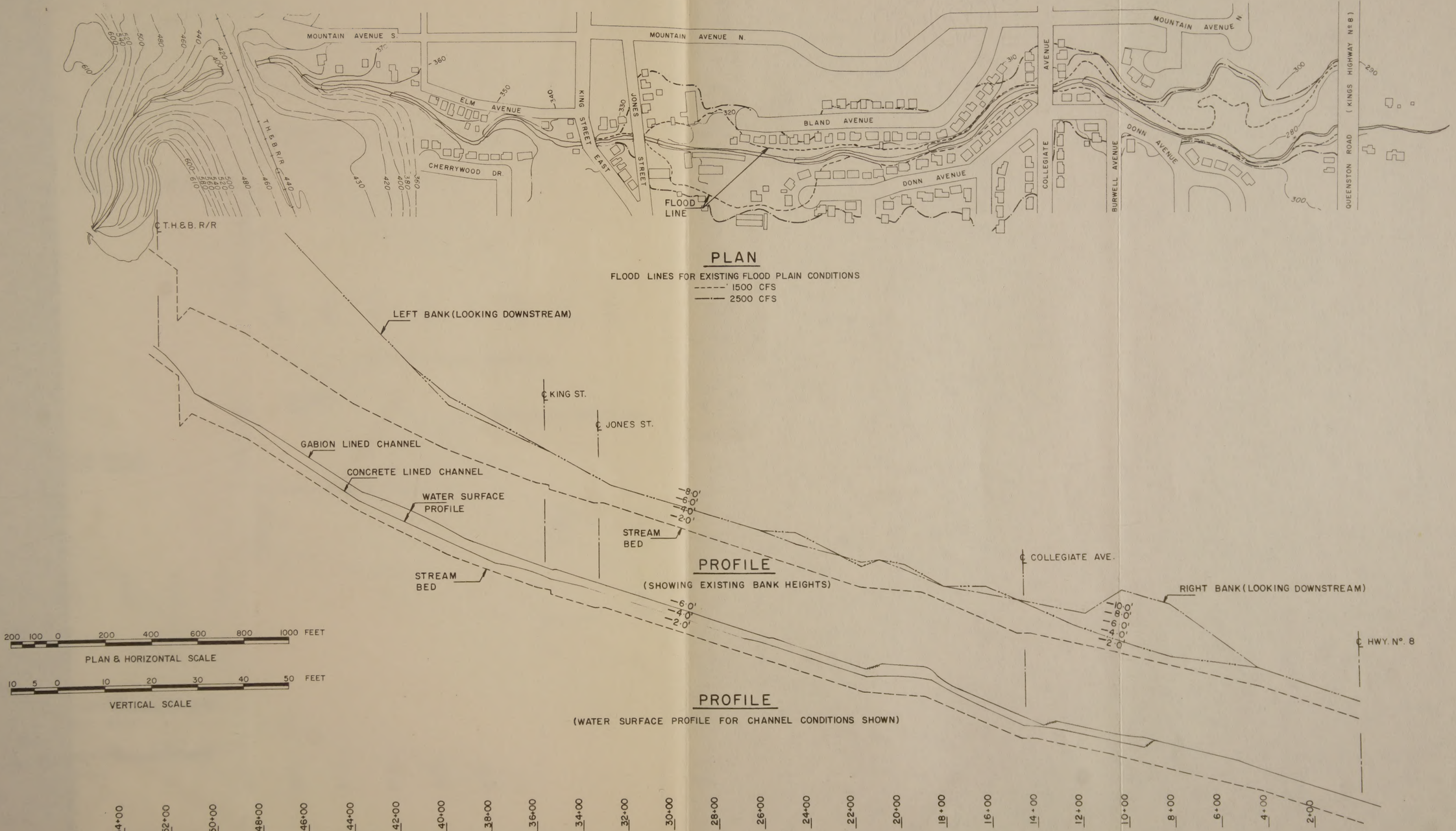


FIG. 8 STONEY CREEK FLOOD CONDITIONS

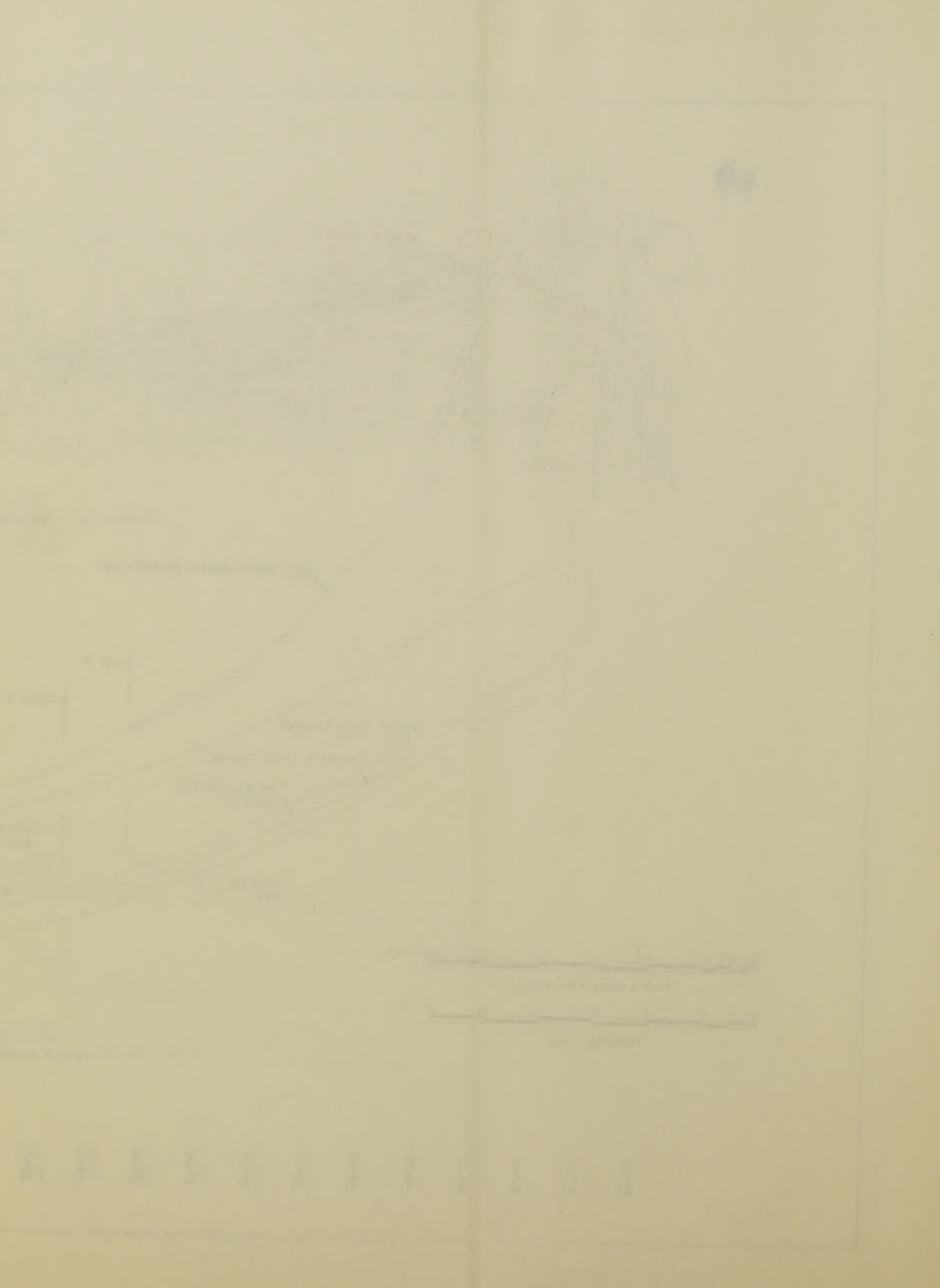
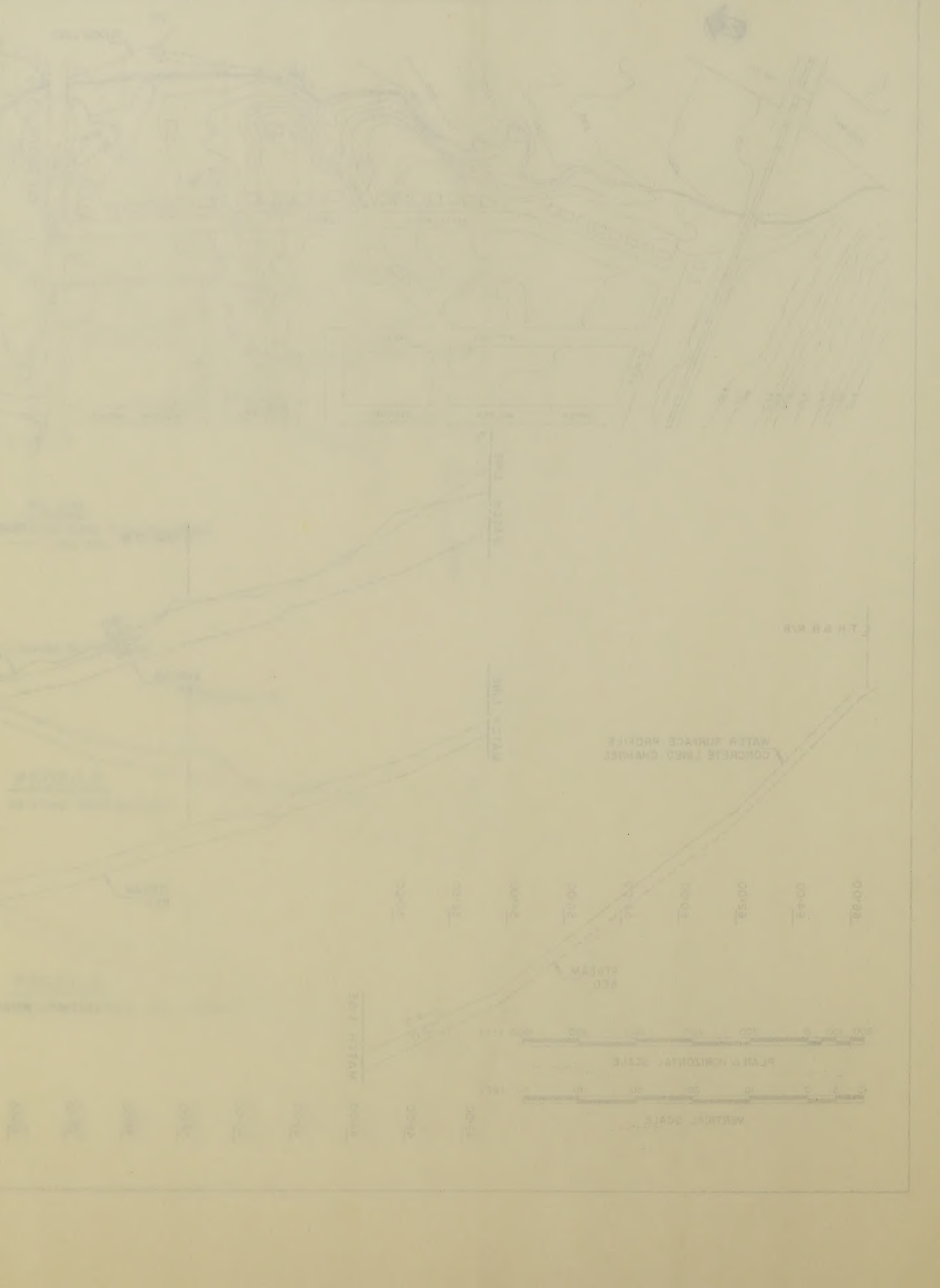
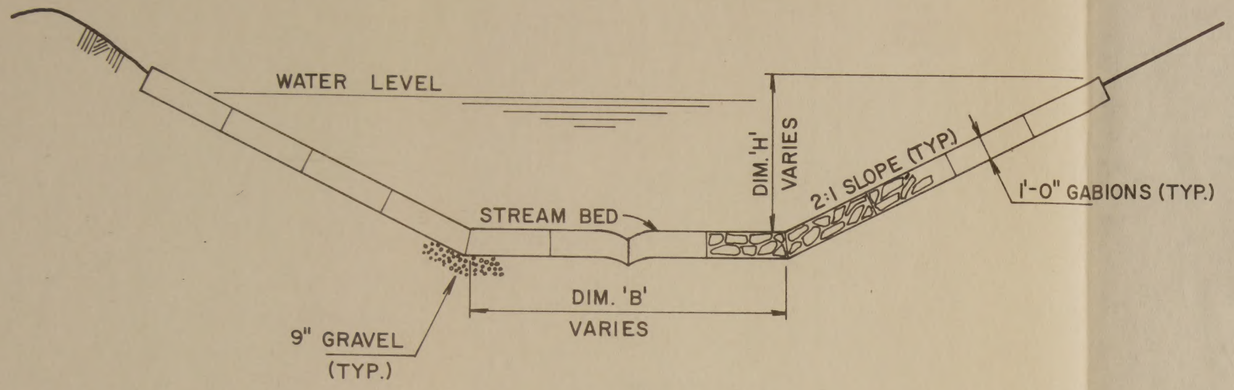
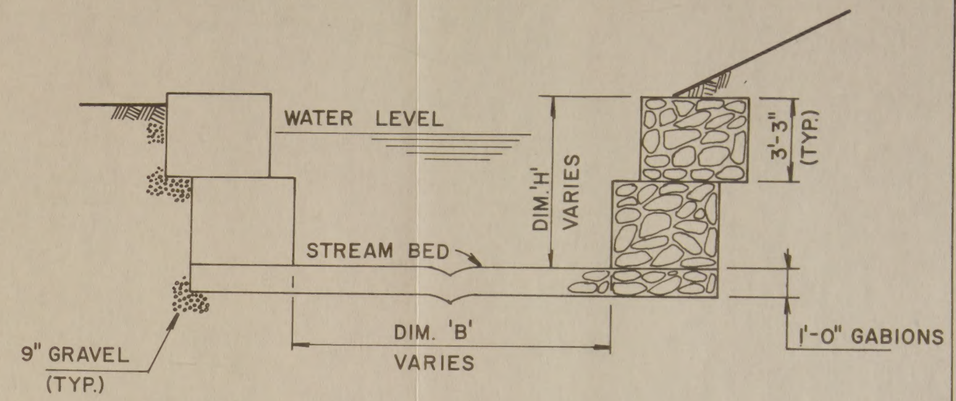


FIG.9 BATTLEFIELD CREEK FLOOD CONDITIONS

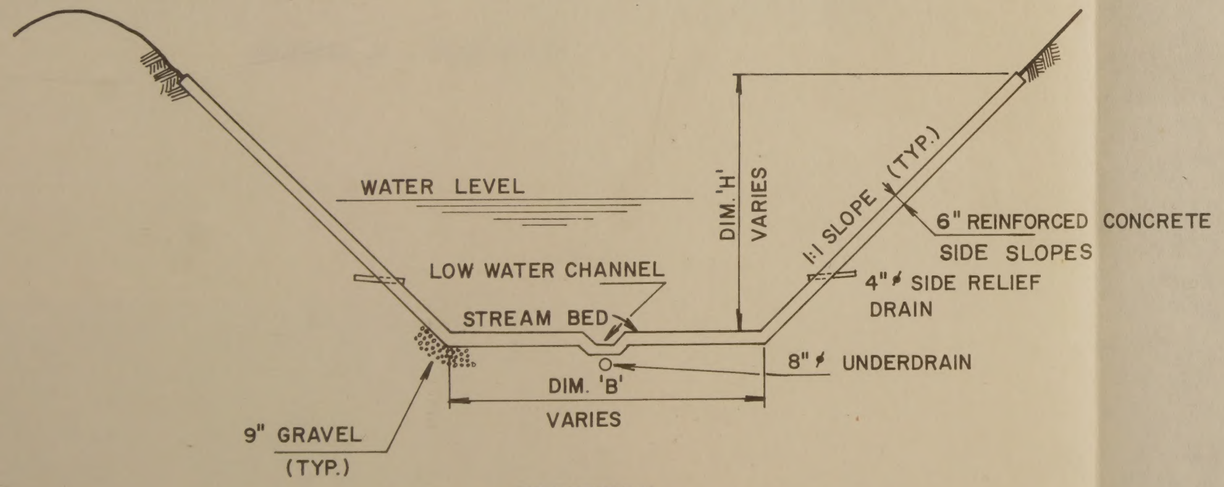




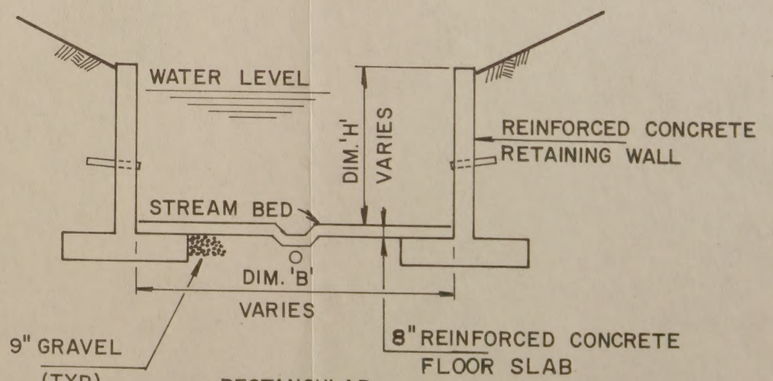
TRAPEZOIDAL
GABION LINED



RECTANGULAR
GABION LINED



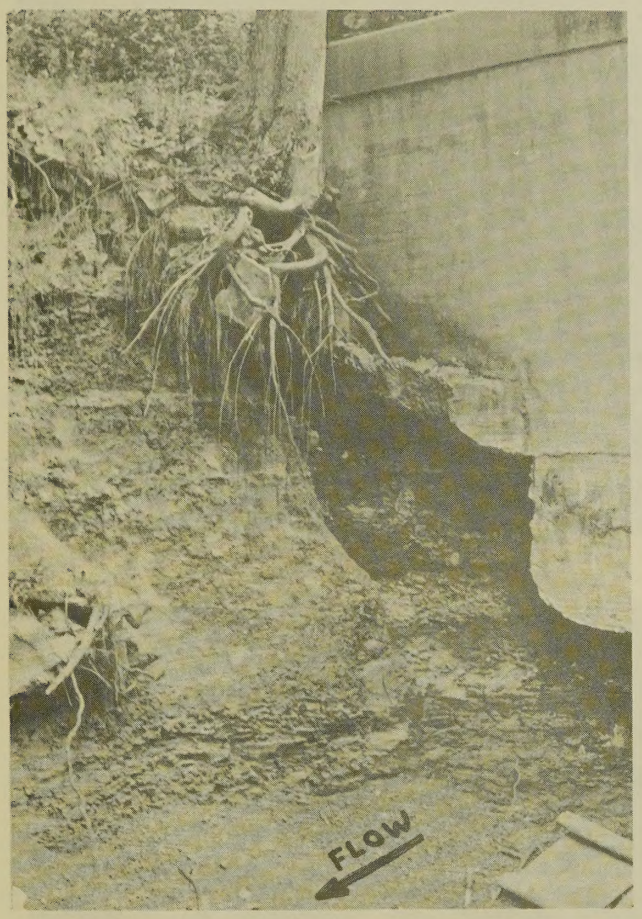
TRAPEZOIDAL
CONCRETE LINED



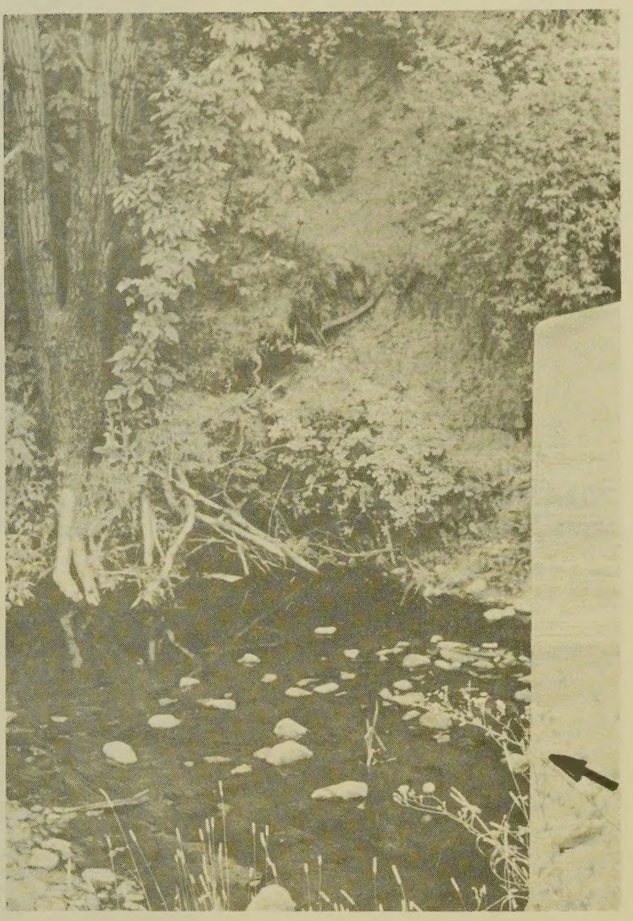
RECTANGULAR
CONCRETE LINED

FIG. 10 TYPICAL CHANNEL CROSS SECTIONS

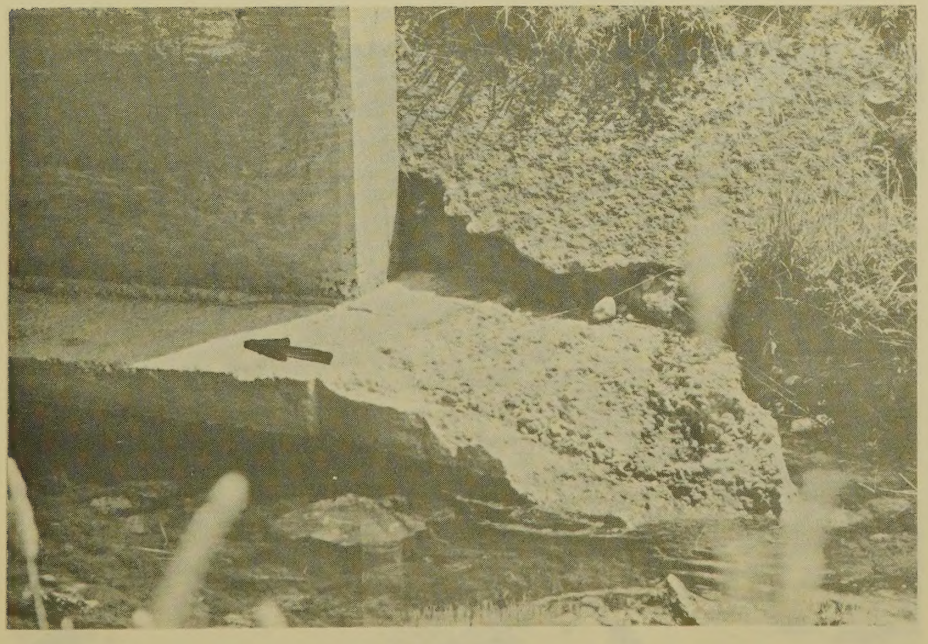
APPENDIX II - PHOTOGRAPHS



NO. 1 EROSION AT RAILROAD CULVERT OUTLET, STONEY CREEK.



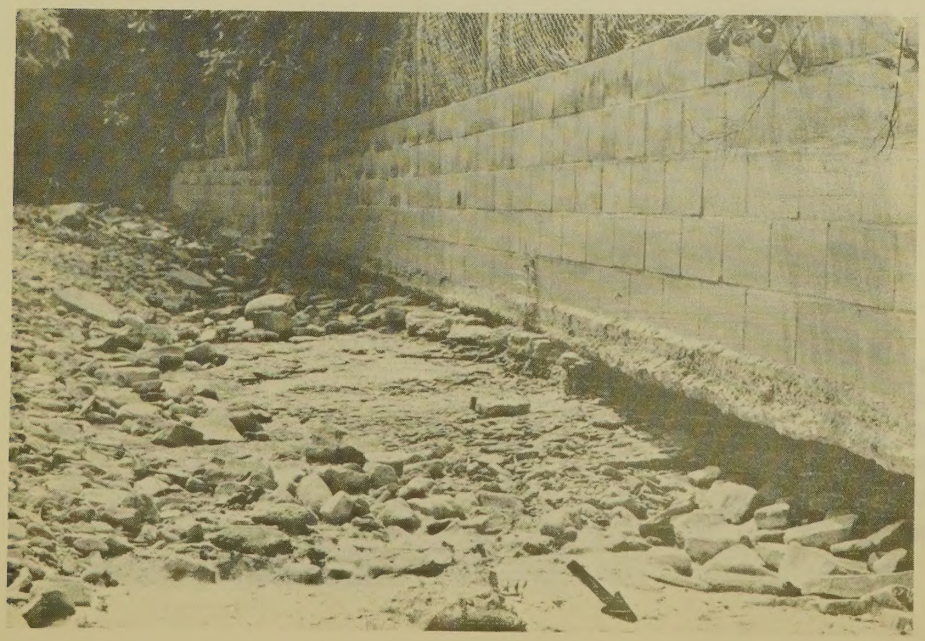
NO. 2 EROSION AT HIGHWAY NO. 8 CULVERT OUTLET, STONEY CREEK.



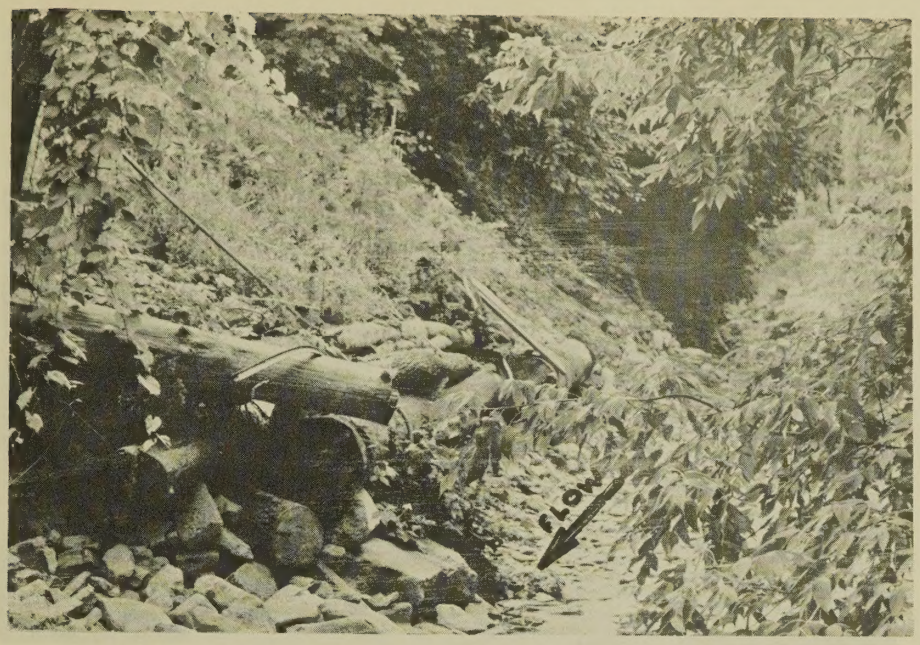
NO. 3 EROSION UNDER BRIDGE FOOTING, STONEY CREEK.

NO. 4 PRIVATE EROSION PROTECTION, STONEY CREEK.

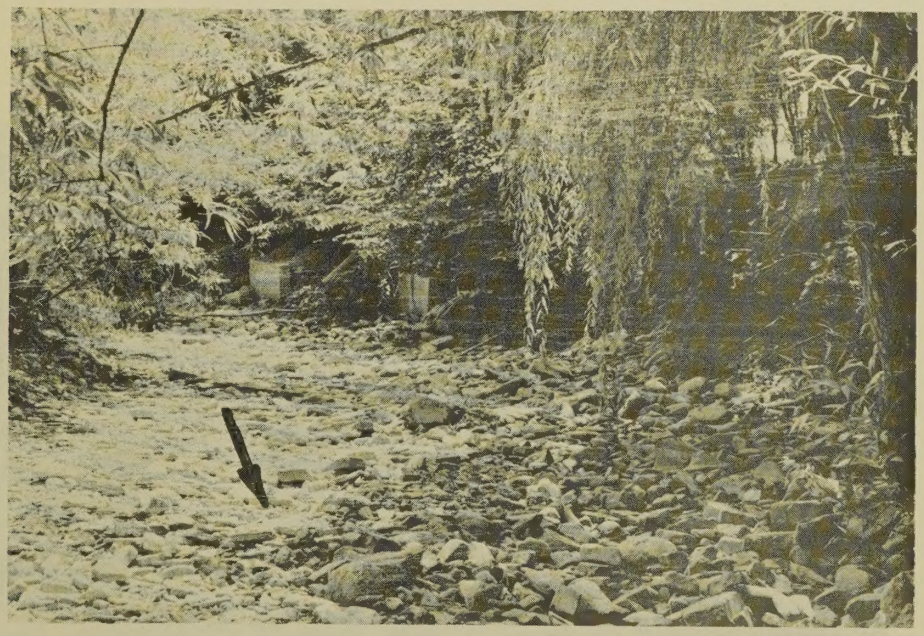
NO. 5 PRIVATE EROSION PROTECTION, STONEY CREEK. SOLID CONCRETE WALL MAY POSSIBLY BE USED AS PART OF CHANNEL LINING.



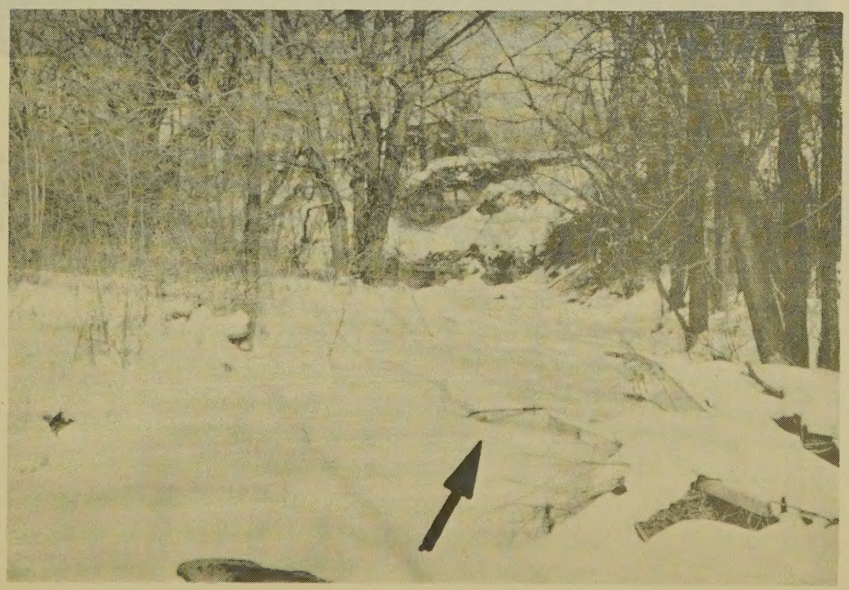
NO. 6 PRIVATE EROSION PROTECTION, STONEY CREEK. CONCRETE FOOTING WAS ORIGINALLY ON EXPOSED BEDROCK. THE ROCK IN THIS AREA IS TOO SOFT TO RESIST EROSION AND WEATHERING.



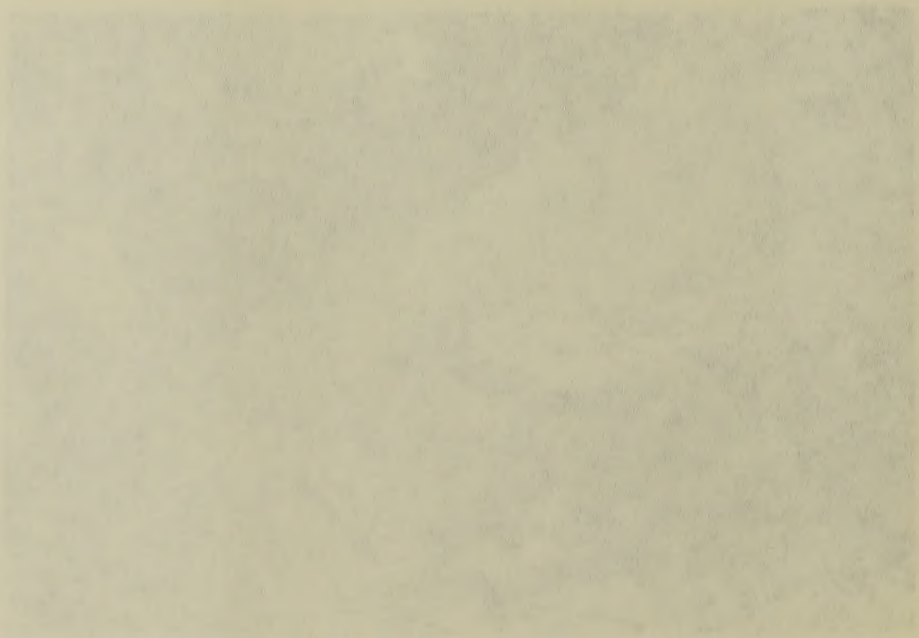
NO. 7 PRIVATE EROSION PROTECTION, STONEY CREEK. OF LITTLE PRACTICAL VALUE.

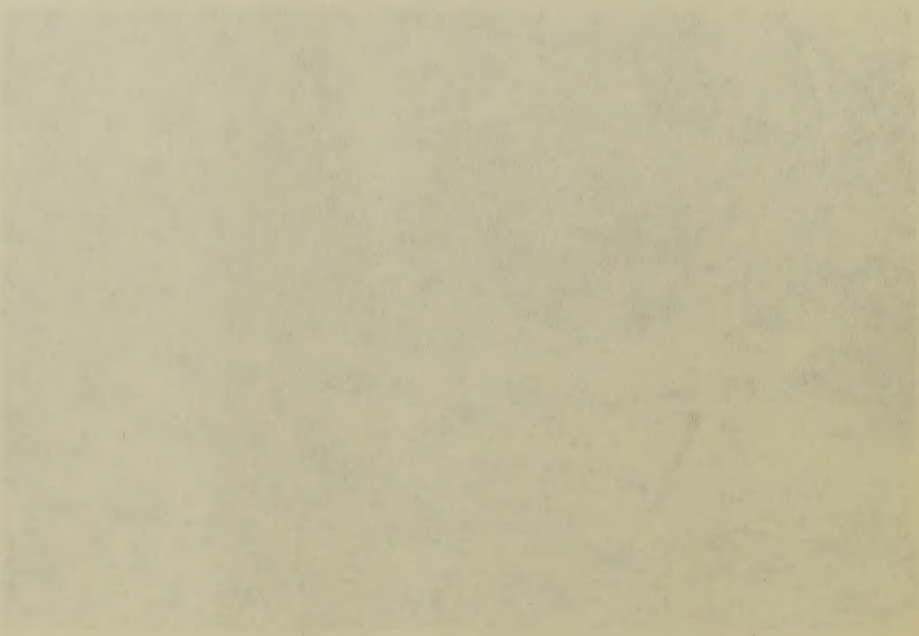


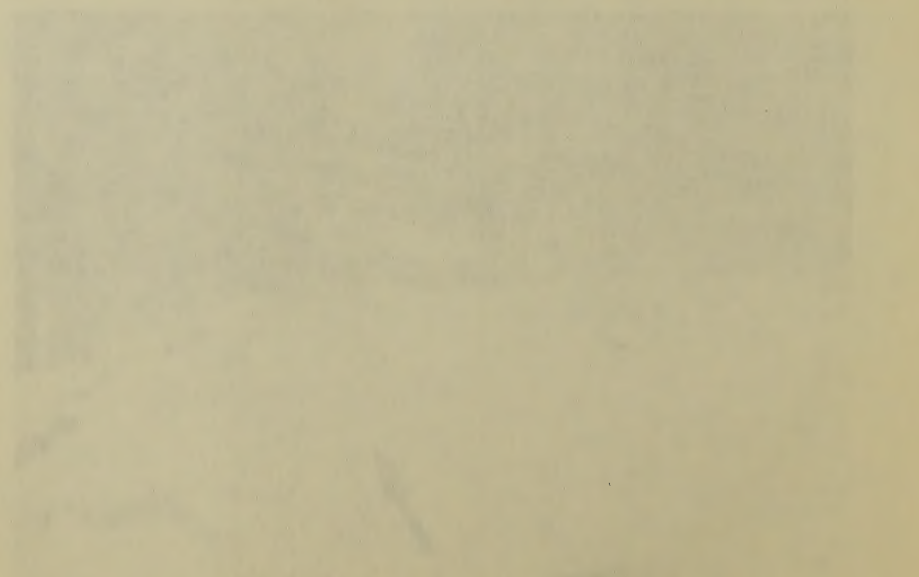
NO. 8 TWO SECTIONS OF CONCRETE BLOCK RETAINING WALL, STONEY CREEK. APPARENTLY INSTALLED TO PREVENT SECTIONS OF BACK-YARD TO SLIDE INTO THE CREEK.



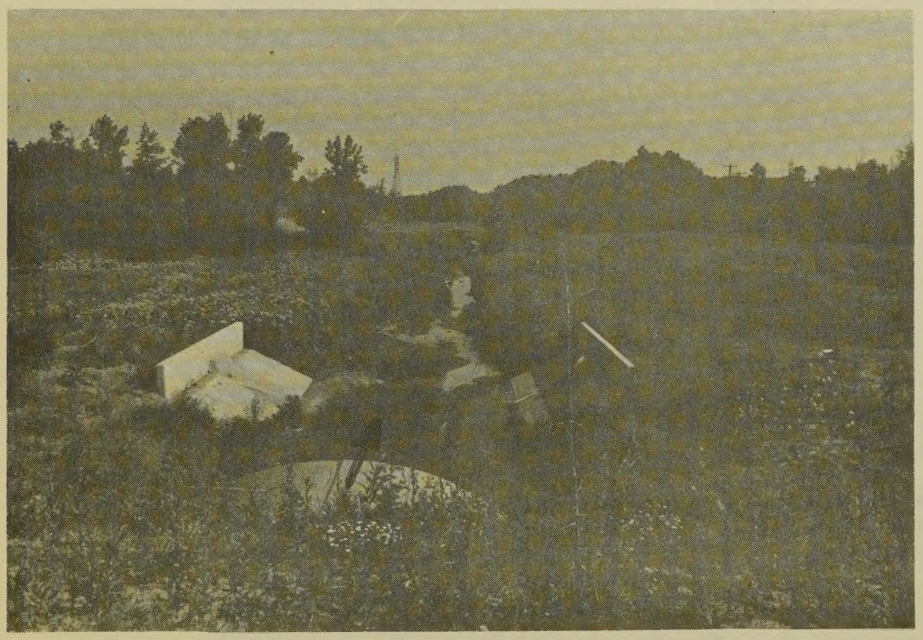
NO. 9 EROSION OF RIGHT STREAM BANK OF STONEY CREEK BETWEEN DONN AVE. AND HIGH-WAY 8. CAN BE ALLEVIATED EITHER BY PROTECTION OR BY RELOCATION OF THE CHANNEL.





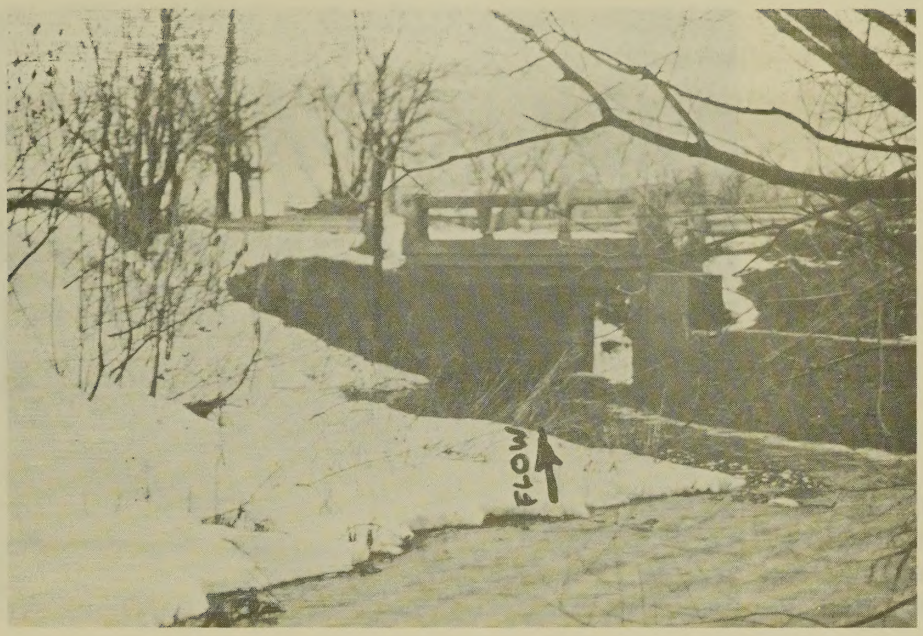


NO. 10 CONFLUENCE OF STONEY CREEK AND BATTLEFIELD CREEK, LOOKING UPSTREAM FROM BARTON STREET.

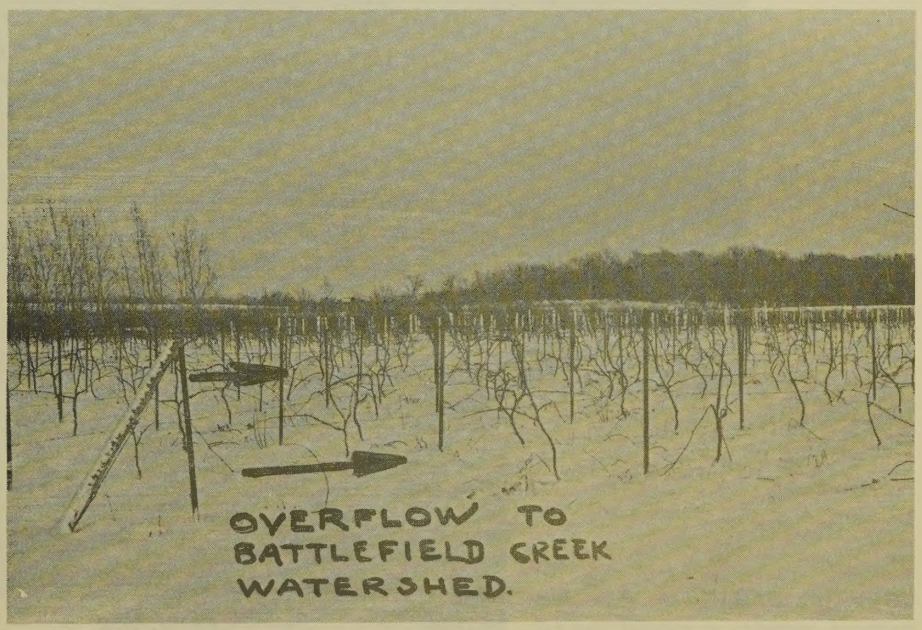


NO. 11 VIEW DOWNSTREAM FROM BARTON STREET.

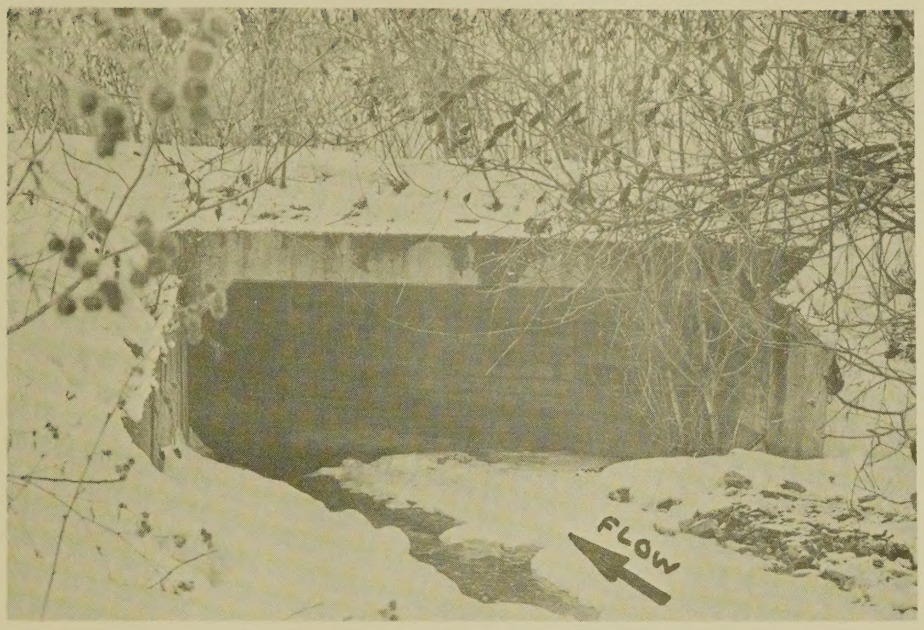
NOTE WELL MAINTAINED CHANNEL AND BROAD, CLEAN FLOOD PLAIN. OCCASIONAL FLOODING OF THE FLOOD PLAIN WOULD NOT CAUSE DAMAGE TO PROPERTY IN THIS AREA.



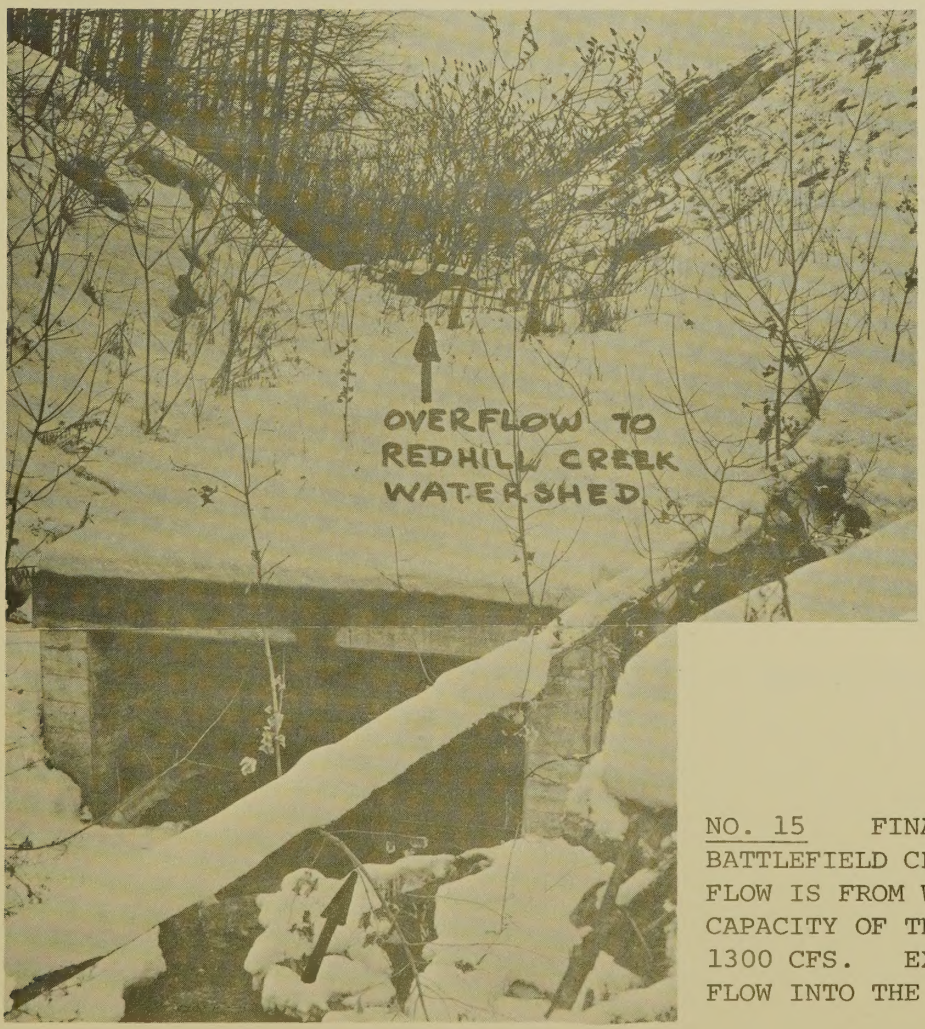
NO. 12 BRIDGE ON STONEY CREEK AT THE EDGE OF THE ESCARPMENT. THIS CONSTRICTION LIMITS THE FLOW TO APPROX. 1500 CFS. REPLACEMENT OF THIS CONDEMNED STRUCTURE SHOULD TAKE INTO ACCOUNT POSSIBLE DOWNSTREAM EFFECTS. DURING HURRICANE "HAZEL" WATER WOULD ALSO OVERFLOW THE ROAD.



NO. 13 AREA OF OVERFLOW FROM THE STONEY CREEK WATERSHED INTO THE BATTLEFIELD CREEK WATERSHED. THE OVERFLOW QUANTITY IS VERY SUSCEPTIBLE TO GRADE CHANGES EITHER IN THIS VINEYARD OR IN THE ELEVATION OF THE ROAD AND IN THE BRIDGE OPENING IN PHOTO NO. 12.



NO. 14 CULVERT UNDER HIGHWAY 20. OVERFLOW FROM THE STONEY CREEK WATERSHED WOULD PASS THROUGH THIS CULVERT, FROM EAST TO WEST.



NO. 15 FINAL CULVERT FOR CONVEYING BATTLEFIELD CREEK UNDER HIGHWAY 20. FLOW IS FROM WEST TO EAST. THE CAPACITY OF THIS CULVERT IS APPROX. 1300 CFS. EXCESS FLOW WOULD OVER-FLOW INTO THE REDHILL CREEK WATERSHED.

APPENDIX III - SOILS REPORT

T 9276 C

REPORT

TO

FOUNDATION OF CANADA ENGINEERING CORPORATION LIMITED

TORONTO ONTARIO

ON

ENGINEERING STUDY

FLOOD AND EROSION CONTROL

TOWN OF STONEY CREEK, ONTARIO

Distribution: 4 copies - Foundation of Canada Engineering Corporation Limited

2 copies - Geocon Ltd

GEOCON

GEOCON LTD

HEAD OFFICE

420 MICHEL JASMIN, DORVAL, QUEBEC

TELEPHONE 631-9827

DISTRICT OFFICES

14 HAAS ROAD
REXDALE, TORONTO, ONT.
TEL. 743-3031

295 EAST 11TH AVENUE
VANCOUVER 10, B.C.
TEL. 879-2620

P.O. BOX 351
FREDERICTON, N.B.
TEL. 475-8967

Rexdale, Ontario
January 27th, 1970

Foundation of Canada Engineering Corporation Limited,
2200 Yonge Street,
Toronto 299, Ontario.

Attention: Mr. A. Bergs, P.Eng.

Re: Engineering Study,
Flood and Erosion Control,
Town of Stoney Creek, Ontario.

Dear Sirs:

This letter reports the results of soil conditions along the courses of Stoney Creek and Battlefield Creek between the Niagara Escarpment and Highway 8. Similar investigation downstream of Highway 8 would provide a logical extension of the scope of the investigation but the area being situated within the boundaries of the city of Hamilton was not included in the scope of the work.

1.0 PROCEDURE

The courses of Stoney Creek and Battlefield Creek were explored on foot on January 13 and on January 20, 1970. Some soil samples were taken by use of a hand pick. Grain size analyses were carried out in our laboratory on three of the samples which were

typical of the soil occurring at different locations in the course of Stoney Creek. Results of the Grain size analyses are plotted on Figure 1.

2.0 SITE AND GEOLOGY

Stoney Creek originates in farmland above the Niagara Escarpment. It plunges down the Escarpment into a gorge. The Toronto, Hamilton and Buffalo Railway (T.H. & B. Railway) track crosses this gorge over a culvert. The gorge reduces to a channel downstream of this culvert and the channel traverses through the Town of Stoney Creek. This gradually changes to a flood plain downstream of Highway 8 which extends to the outlet of the Creek into Lake Ontario. The creek is generally paralleled along its banks by urban development extending roughly from the flood plain to about 500 feet downstream of the Toronto, Hamilton and Buffalo Railway track culvert.

Battlefield Creek which is situated west of the Stoney Creek also originates in farmland above the Niagara Escarpment. It falls down the Escarpment, crosses Highway 20 and T.H. & B Railway tracks through culverts and follows a winding course through a wide valley to within approximately 200 yards upstream of King Street. Residential houses exist on Battlefield Drive which lies between the T.H. & B. Railway track and King Street and runs roughly parallel to but well away from the Creek. Downstream of King Street the course of the creek is relatively smooth. Compared to Stoney Creek the urban development along the banks of the Creek

is less and the stream course is generally unobstructed. Battlefield Creek joins Stoney Creek in the flood plain south of Barton Street within the limits of the City of Hamilton.

3.0 SOIL CONDITIONS

3.1 General

The bed width of Stoney Creek in particular was found to be non-uniform. Obstacles caused by slopes formed by fill and extending into the Creek bed were common. At places Creek banks are formed by reinforced concrete or concrete block retaining walls, steel grating, wooden logs secured by steel straps, wooden boards nailed to wooden posts, dry rubble, stone masonry and by gabions.

A brief description follows of the soil conditions of the area traversed by Stoney Creek and Battlefield Creek. This is based mostly on visual examination of channel sections. For facility in description the length of the Stoney Creek course within the limits of the investigation is divided into upper, upper middle, lower middle and lower stretches and the Battlefield Creek is divided into upper, middle and lower stretches. These are approximately indicated in Drawings T 9276C1 and T 9276C2

3.2 Topsoil

Topsoil consisting of brown to dark brown silty clay with organics was encountered throughout the course of the two creeks. Gravel to cobble sizes were occasionally

3.2 Topsoil - Continued

present in the topsoil. The thickness of this stratum ranged generally between 6 inches to 1 foot.

3.3 Brown Sandy Till

Underlying the topsoil a thin stratum of brown till of the order of 5 feet or less was encountered in the upper reaches of Stoney Creek. This stratum lies well above the bed of the Stoney Creek for a length of about 800 feet downstream of the T.H. & B. Railway culvert. The thickness of this stratum is relatively greater along the banks of Battlefield Creek which emerging from its culvert under Highway 20 has its bed located within this stratum for a length of about 1100 feet; the length comprising the upper stretch in Drawing T 9276-2. The till stratum of both Stoney Creek and Battlefield Creek is followed by a silt and clay stratum which further downstream are followed again by a till stratum. In the case of Stoney Creek the latter stratum occurs in the Lower Middle Section and in Battlefield Creek in the Lower Section as indicated in Drawings T 9276C1 and T 9276C2 respectively. This till stratum does not appear continuous with that encountered in the upper stretches of the two creeks because of an intervening clay stratum. However lithologically the two strata are identical.

Grain size analysis tests were carried out on two samples of the till taken from the Lower Middle Stretch of

3.3 Brown Sandy Till - Continued

Stoney Creek. The results of these tests are shown on Figure 1. It is seen there from that in the fraction smaller than 3/4 inch size the clay content is less than 10 percent and the combined silt and clay fraction is less than 30 percent in the samples. The till is described as sandy till. The till has the character of the Queenston red shale and has red shale gravel to cobble sizes not reflected in the grain size curve.

3.4 Brown to Grey Sandy Silt to Silty Clay

The bed of Stoney Creek is located within this stratum in the upper middle stretch and of Battlefield Creek in the middle stretch as shown in Drawings T 9276C1 and T 9276C2. The thickness of the stratum is variable. A height of about 10 feet above Stoney Creek bed was exposed on the right looking downstream bank about 700 feet downstream of the T.H. & B. Railway culvert. A further 150 feet downstream the height of this bank reduces to 5 feet. Similarly about 800 feet south of the T.H. & B. Railway culvert the right bank of Battlefield Creek shows above creek bed a height of this stratum of about 12 feet on the right bank and of about 10 feet on the left bank.

The Stoney Creek bed lies within this stratum for a length of approximately 350 feet and the Battlefield Creek bed within this stratum has a length of about 650 feet.

3.4 Brown to Grey Sandy Silt to Silty Clay - Continued

Results of grain size analysis carried out on one surface sample of this stratum from the upper middle stretch of Stoney Creek is shown in Figure 1. The sample was found to have 12 percent clay size fraction, 46 percent silt and 30 percent sand. Accordingly the sample is described as sandy silt. However silty clay also occurs within this stratum, as such this is described as sandy silt to silty clay.

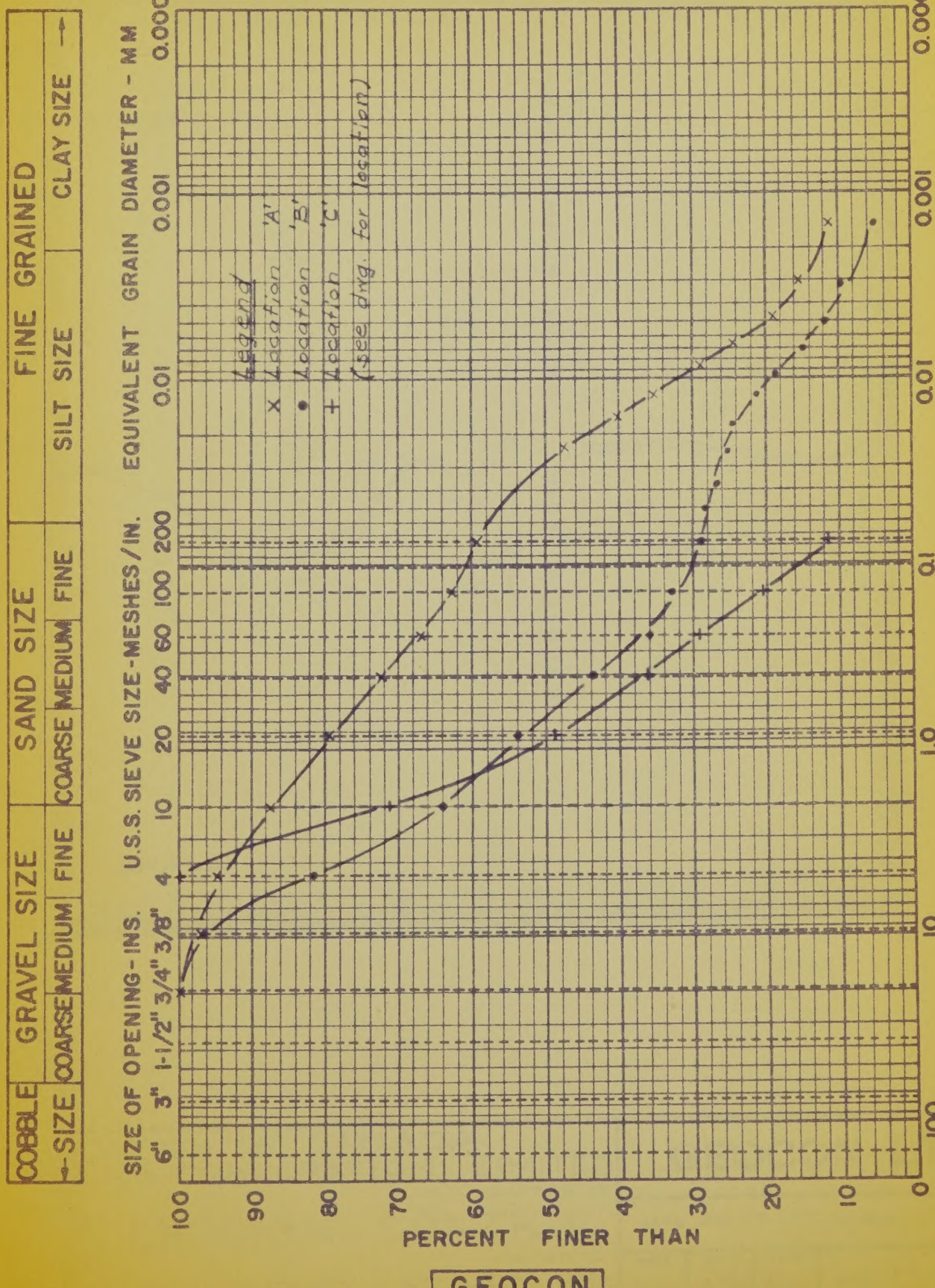
3.5 Shale

This stratum was encountered at the bed and banks of Stoney Creek in the upper and lower stretches as indicated in Drawing T 9276-1. It is also known to underlie all the other strata of till and of silt and clay encountered elsewhere along the courses of both Stoney Creek and Battlefield Creek.

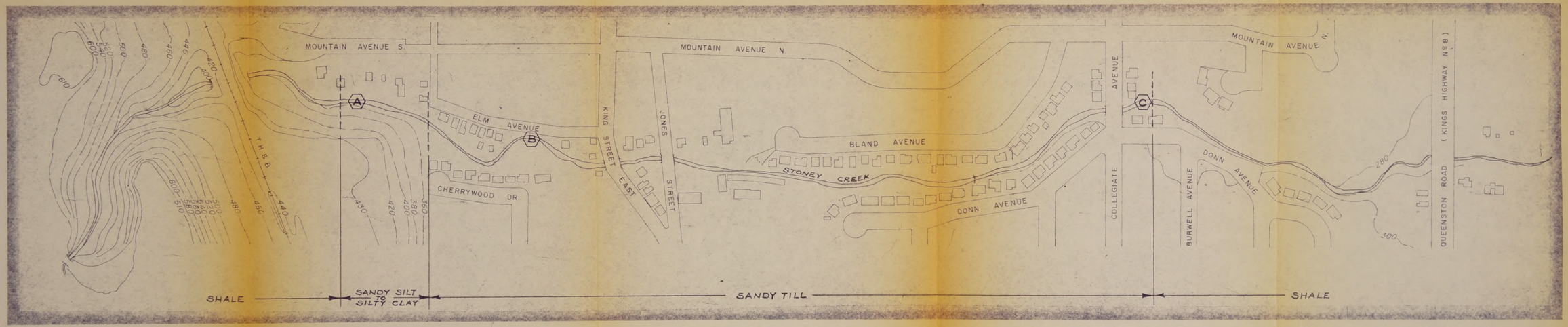
The banks of shale along Stoney Creek were almost vertical. On the left bank of this creek about 50 feet upstream of the T.H. & B. Railway culvert the vertical exposure was about 8 feet. The right bank had a exposed vertical face of about 30 feet at a distance of about 100 feet upstream of the culvert. Just downstream of this culvert this bank had an vertical exposure of about 15 feet. The heights of banks in the lower stretch of Stoney Creek are not so high, consequently bank exposures are small.

GRAIN SIZE DISTRIBUTION

APPENDIX
FIGURE 1
PROJECT T92760



GEOCON



NOTE: THE SOIL DESCRIPTIONS SHOWN REFERS ONLY TO CREEK BED STRATIGRAPHY

(A) SOIL SAMPLE (SEE FIG. No. 1)

REFERENCE	
DWG. NO.	DESCRIPTION
—	PLAN - FOUNDATION OF CANADA, ENG. CORP. LTD.

FOUNDATION OF CANADA ENGINEERING CORPORATION LIMITED
HAMILTON ONTARIO
FLOOD & EROSION CONTROL
STONEY CREEK ONTARIO
PRELIMINARY SOIL SURVEY - STONEY CR.

GEOCON LTD.

DATE JAN. 23, 1970 SCALE 1" = 200'

MADE	CHKD	APPD	No. T9276C-1
A.E.L.	A.S.G.	D.L.P.	

NOTE: THE SOIL DESCRIPTIONS SHOWN REFERS ONLY TO CREEK BED STRATIGRAPHY

REFERENCE	
DWG. NO.	DESCRIPTION
—	PLAN - FOUNDATION OF CANADA, ENG. CORP. LTD.

FOUNDATION OF CANADA ENGINEERING CORPORATION LIMITED
HAMILTON ONTARIO

FLOOD & EROSION CONTROL

STONEY CREEK ONTARIO

PRELIMINARY SOIL SURVEY - BATTLEFIELD CR.

GEOCON LTD.

DATE JAN. 23, 1970 SCALE 1" = 200'

DRAWN	CHKD	APPD
AEL	ASG	

No. T9276C-2

HAMILTON PUBLIC LIBRARY
3 2022 21335941 3

URB